GenRad

GR1232-A, -AP Tuned Amplifier and Null Detector

Form 1232-0100-00

Instruction Manual

Contents

GR1232-A, -AP Tuned Amplifier and Null Detector

and GR-1240-A, -AP Bridge Oscillator-Detector

Form 1232-0100-00

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Concord, Massachusetts, U.S.A. 01742
December, 1988

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Refer to para 4.3 for battery installation.

GenRad

WARRANTY

We warrant that this product is free from defects in material and workmanship and, when properly used, will perform in accordance with applicable GenRad specifications. If within one year after original shipment it is found not to meet this standard, it will be repaired or, at the option of GenRad, replaced at no charge when returned to a GenRad service facility. Changes in the product not approved by GenRad shall void this warranty. GenRad shall not be liable for any indirect, special, or consequential damages, even if notice has been given of the possibility of such damages.

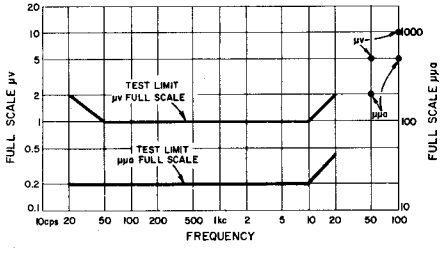
THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Specifications

TYPE 1232-A TUNED AMPLIFIER AND NULL DETECTOR

Frequency Response: TUNABLE FILTERS: 20 Hz to 20 kHz in 3 ranges; between 2% and 6% bandwidth to 15 kHz; 2nd harmonic at least 34 dB down from peak, 3rd at least 40 dB down; rejection filter on two highest ranges reduces 60-Hz level to at least 60 dB below peak response (50-Hz level is down >50 dB). Dial accuracy is ±3%. FIXED-TUNED FILTERS: 50 kHz, 2nd harmonic is 44 dB down; 100 kHz . . . 53 dB down. FLAT RESPONSE: ±3 dB from 20 Hz to 100 kHz.
Sensitivity: See plot. Typically better than 0.1 μV over most of the frequency range.
Noise Level: REFERRED TO INPUT: See plot. Noise figure at 1 kHz is less than 2 dB at an optimum source impedance of 27 kΩ. REFERRED TO OUTPUT: Less than 5 mV on FLAT filter-frequency position, min gain setting, and −20-dB switch position; less than 50 mV in MAX SENS position.
Input: IMPEDANCE: Approx 50 kΩ at max gain; varies inversely with gain to 1 MΩ at min gain. MAX SAFE VOLTAGE: 200 V ac or 400 V dc.
Output: VOLTAGE GAIN: Approx 120 dB on the tunable ranges: 100 dB, flat range; 106 dB at 50 kHz; 100 dB at 100-kHz position. LEVEL: 1 V into 10 kΩ when meter indication is full scale. INTERNAL IMPEDANCE: 3 kΩ. METER LINEARITY: dB differences are accurate to ±5% ±0.1 division for inputs of less than 0.3 V. COMPRESSION (meter switch to LOG): Reduces fullscale sensitivity by 40 dB. Does not affect bottom 20% of scale. ATTENUATION (meter switched to −20 dB): Linear response with 20-dB less gain than MAX SENS.
Distortion (filter switch in FLAT position): <5% (due to meter rectifiers).
Terminals: Input, GR874®coaxial connector; output, binding posts.
Available: 1232-P2 Preamplifier to maintain sensitivity of 1232-A at low frequencies when operating from a source impedance above 100 kΩ; rack-adaptor sets (see below) convert 1232 alone, or with companion instruments, to 19-in. rack-mount width.
Power: 12 V dc, from 9 mercury (M72) cells in series. Est battery life 1500 hours. Optionally, a rechargeable battery (non-mercury) can be supplied on special order.
Mechanical: Convertible bench cabinet. DIMENSIONS (wxhxd): Bench, 8x6x7.5 in. (203x152x190 mm). WEIGHT: 5.75 lb (2.6 kg) net, 8 lb (3.7 kg) shipping.

Description	Catalog Number
1232-A Tuned Amplifier and Null Detector	**1232-9701**
1232-AP Tuned Amplifier and Null Detector, with preamplifier	**1232-9829**
Rack-Adaptor Sets	
480-P308, for 1232-A alone	**0480-9838**
480-P316, for 1232-A with 1310 or 1311 oscillator or similar 8-in. wide instrument with convertible-bench cabinet	**0480-9836**
480-P317, for 1232-AP (with preamp) and companion 8-in. instrument	**0480-9837**
Replacement Battery, 9 req'd	**8410-1372**



Minimum input for full-scale meter deflection as a function of frequency.

TYPE 1232-P2 PREAMPLIFIER

(Accessory supplied with Type 1232-AP and Type 1240-AP only)

Voltage Gain: Approx 0.7.
Noise (referred to input): Open-circuit equivalent 0.1 pA; short-circuit equivalent, 0.3 μV (when used with Type 1232-A tuned to 100 Hz).
Impedances: INPUT: >100 mΩ in parallel with 70 pF. OPTIMUM SOURCE: 3 MΩ. OUTPUT: 10 kΩ.
Connectors: GR874® on cables, input and output.
Power: 12 V, 200 μA, supplied by 1232-A.
Mechanical: Special cabinet. DIMENSIONS (wxhxd): 0.75x6x7.5 in. (19x152x190 mm). WEIGHT: 0.94 lb (0.43 kg) net, 4 lb (1.9 kg) shipping.

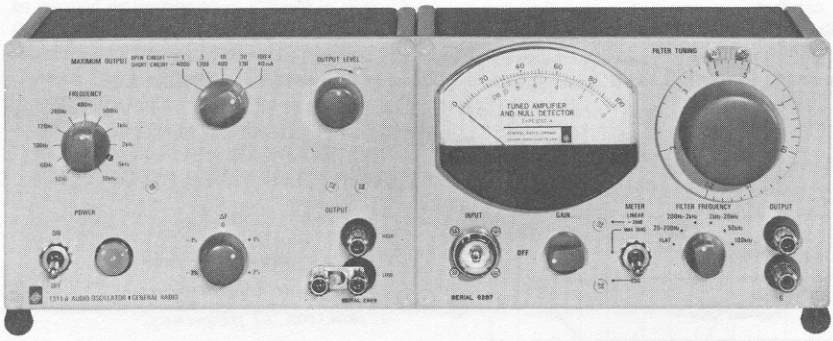
Description	Catalog Number
1232-P2 Preamplifier	**1232-9602**

TYPE 1240-A, -AP BRIDGE OSCILLATOR-DETECTORS

The Type 1240-A Bridge Oscillator-Detector is a rigid assembly of a Type 1311 Audio Oscillator and a Type 1232 Tuned Amplifier and Null Detector. The Type 1240-AP includes the Type 1232-P2 Preamplifier in addition to the above instruments. These compact assemblies are convenient for use with audio-frequency bridges and other null-balance devices.

The units are secured with an Adaptor Plate Set (P/N 0480-9836 for 1240-A, 0480-9837 for 1240-AP) and bolted together near the rear of the instruments. The assembly fits a standard 19-inch relay rack. For bench use, the two wings of the relay-rack adaptor set can be removed and the four rubber feet can be installed in the corners of the oscillator-detector assembly.

Operating instructions for the Type 1232-A or -AP Tuned Amplifier and Null Detector are given in this book. A separate instruction book is supplied for the Type 1311 Audio Oscillator.



GR 1240-A Bridge Oscillator-Detector.

Introduction—Section 1

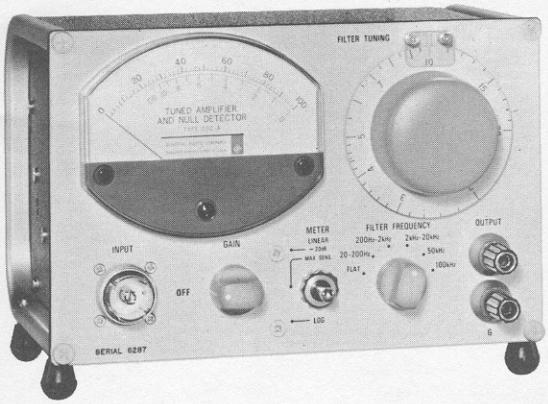


Figure 1. Type 1232-A Tuned Amplifier and Null Detector.

1.1 PURPOSE

The Type 1232-A Tuned Amplifier and Null Detector (Figure 1) is a sensitive, low-noise amplifier continuously tunable from 20 Hz to 20 kHz, with additional fixed-tuned frequencies of 50 kHz and 100 kHz. Intended primarily as a bridge detector, the Type 1232-A can also be used as a detector of high-frequency modulated signals (with a crystal demodulator), a wave analyzer at audio frequencies, and a preamplifier for transducers.

The Type 1232-P2 Preamplifier can be added to improve the signal-to-noise ratio and consequently the effective sensitivity of the Type 1232-A when the latter is to be driven by very high (greater than 100 kΩ) impedance sources.

1.2 DESCRIPTION

The Type 1232-A consists of a low-noise preamplifier, a frequency-selective stage (feedback amplifier and null network), an amplifier-compressor stage, and a meter-rectifier circuit (see block diagram, Figure 2). The total gain of the amplifier is about 120 dB. Full-scale meter sensitivity is 1 microvolt or better over most of the frequency range.

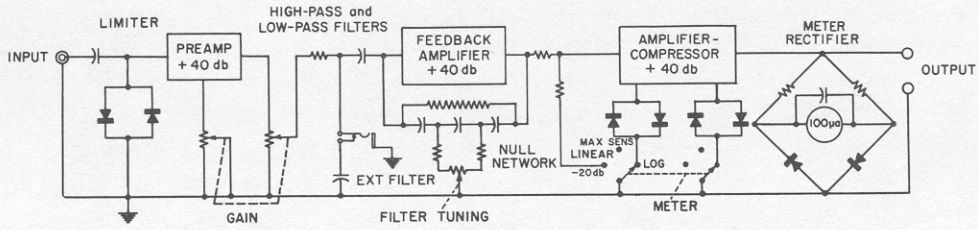


Figure 2. Functional diagram of the null detector.

With the Type 1632 Inductance Bridge, this null detector permits inductance balances to a resolution of 1 part in 10^6. Comparable precision for capacitance balance can be obtained with the Type 1615 and 716 Capacitance Bridges.

The amplifier is powered by 12 Vdc, supplied by nine mercury batteries in series. The output is 1 V into 10,000 ohms.

Front mountings are extendible to tilt instrument face.

The Type 1232-P2 Preamplifier is a detachable accessory that consists of a low-noise field-effect transistor used in common-source configuration. Power for the preamp is provided by the B + supply of the Type 1232-A.

1.3 CONTROLS AND CONNECTORS OF THE TYPES 1232 AND 1232-P2.

TABLE 1

	Name	*Type*	*Function*
Type 1232	FILTER TUNING	Continuous rotary control	Tunes filter within selected tuning range.
	FILTER FREQUENCY	6-position rotary switch	Selects desired frequency characteristic; tuning-frequency range of 20-200 Hz, 200 Hz-2 kHz, or 2-20 kHz; flat, 50-kHz or 100-kHz response.
	GAIN	Rotary control	Turns instrument on or off and controls gain.
	METER	3-position toggle switch	Selects full-gain linear, -20-dB linear, or logarithmic response.
	INPUT	GR874 Locking Coaxial Connector	Input terminals.
	OUTPUT	Pair of Type 938 Binding Posts	Output terminals.
	EXTERNAL FILTER	Phone jack	Connection for external filter.
Type 1232-P2	HIGH Z, LOW Z	Toggle switch	Determines whether Preamplifier is included in input to Type 1232 (HIGH Z) or shunted (LOW Z).
	INPUT	GR874 Connector and Cable Assembly	Input terminals.
	OUTPUT	GR874 Connector and Cable Assembly	Output terminals (to be applied to INPUT of Type 1232).

1.4 USE OF EXTERNAL FILTERS.

Filters can be connected at the EXTERNAL FILTER jack. When a telephone plug is inserted in this jack, the built-in shunt filter is disconnected. The external filter may be either a series-tuned circuit to trap out an undesired frequency or an antiresonant parallel-tuned circuit to improve the selectivity at the desired frequency. For the purpose of calculating the Q of the external filter, the source impedance is about 700 ohms. Since the external filter is plugged into the circuit at a point beyond the 60-Hz rejection filter and where there is 80-dB gain to the meter circuit, it is important that the external filter be shielded and preferably that it use a toroidal inductor for minimum sensitivity to hum pickup.

Principles of Operation—Section 2

2.1 PREAMPLIFIER OF THE TYPE 1232-A.

The preamplifier stage of the Type 1232-A Tuned Amplifier and Null Detector is designed to minimize noise from both low-impedance sources, such as inductance bridges at low frequencies, and high-impedance sources, such as capacitance bridges at low frequencies. A transistor with a noise figure of 3 to 5 dB at an optimum source impedance of 50 kilohms is used. By use of negative feedback, the input impedance of the preamplifier is also made 50 kilohms, and the noise level indicated on the output meter is relatively constant and independent of source impedance.

The input transistor is protected from possible damage due to large overloads by a limiter consisting of a series capacitor and two shunt silicon rectifier diodes. This circuit effectively prevents signals greater than 1 volt, peak-to-peak, from reaching the input transistor and does not contribute noise or distortion to low-level signals.

Maximum gain of the preamplifier is about 40 dB, which is adequate to swamp the noise of succeeding stages. After preamplification, the signal passes through a set of series and shunt filters, which are designed to reject frequencies above and below the selected tuning range. Typical filter characteristics are shown in Figure 3. On all switch positions except FLAT and 20 – 200 Hz, another rejection filter reduces the response at 60 Hz to greater than 60 dB below peak response.

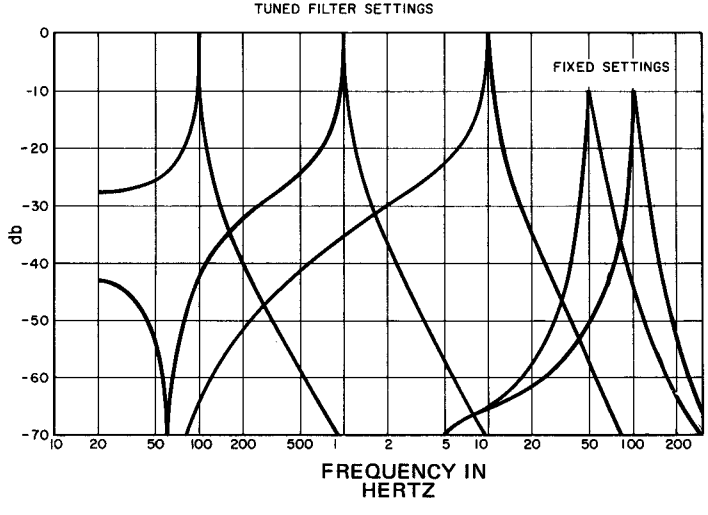


Figure 3. Typical filter characteristics of the Type 1232-A.

2.2 FREQUENCY-SELECTIVE AMPLIFIER.

This amplifier consists of three stages with negative feedback through a null network, which has its null at the desired operating frequency. Since there is negative feedback at all frequencies but the desired one, the over-all response peaks at this frequency and is roughly equivalent to that of a tuned circuit with a Q of about 20 (5% bandwidth). The unique feature of this null network is its one-potentiometer tuning. Many null networks require three variable elements, either ganged capacitors or ganged potentiometers. This leads to many problems in alignment and tracking the three elements to maintain a good null. The Hall null network has a perfect null in theory for any position of the tuning potentiometer, and it is possible to cover a 10:1 tuning range with a 40-dB exponential potentiometer. Tuning capacitors are switched to change ranges, maintaining the impedance level of the null network approximately constant for the three tuning ranges.

Since the 50-kHz and 100-kHz null networks need not be tunable, conventional twin-T null networks are used.

On the FLAT position of the range switch, all filters are switched out and the frequency response is flat to within ±3 dB from 20 Hz to 100 kHz. The overall gain of the amplifier is reduced by 26 dB to keep the noise level on the output meter equal to about 10 percent of full scale at maximum gain.

2.3 NULL NETWORK.

The Type 1232-A Tuned Amplifier and Null Detector uses an RC null network with only one variable component to adjust the frequency of the null. This avoids the use of ganged variable components, which must track closely to maintain stability when used in highly selective feedback amplifiers. The network (Figure 4), consisting of three-terminal RC circuits, gives a complete null without being balanced against a voltage divider, and permits frequency adjustment with a single potentiometer. The tuning law for this circuit is

$$\omega_o = \frac{1}{RC\sqrt{\alpha(1-\alpha)\,(1+2k)}}$$

In order to span a 10-to-1 logarithmic frequency range, the potentiometer must have an exponential characteristic of over 100 to 1.

The selectivity of the transfer admittance, $\frac{I_o}{E_{in}}$ (or y_{21}) is quite constant

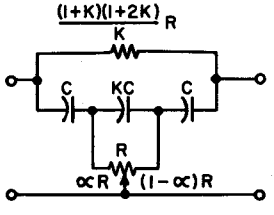


Figure 4. Null circuit of the Type 1232-A Tuned Amplifier and Null Detector.

as the null frequency is changed. In order to use this characteristic, the network must be driven by and loaded by low impedances. Therefore, it is used in a feedback circuit with an amplifier having low input and output impedances and a transfer resistance $\frac{E_o}{I_{in}}$ (or a real z_{21}) that is chosen to give the desired selectivity. This combination provides a second-harmonic rejection of 34 dB over each 10-to-1 frequency range.

2.4 AMPLIFIER-COMPRESSOR.

With the METER switch set to either linear position, the amplifier-compressor functions as a linear amplifier, driving the meter rectifier circuit and supplying the output terminals with about 1.4 V for full-scale deflection of the meter. The MAX SENS position provides full gain for very low-level applications. When maximum sensitivity is not required, use the LINEAR – 20 dB position for a less noisy output. With this switch setting, the noise generated in the input and selective amplifier stages is attenuated. The dc supplied to the last transistor is sufficient to drive the output meter to full scale, but very little more, so that it is impossible to damage the meter by overdriving the amplifier.

For null detector use, the METER switch is thrown to LOG, effectively compressing the upper part of the meter scale. Two pairs of silicon diodes are switched in shunt with the collector resistors of two transistors to provide a nonlinear collector impedance. Owing to the voltage offset of the silicon diodes, the bottom 20 percent of the meter scale is virtually unaffected. A signal level corresponding to 100 percent deflection for linear response will drop to 50 percent for logarithmic response. An increase of 20 dB increases the reading to 80 percent, and another 20 dB raises the reading to 100 percent.

2.5 METER CIRCUIT.

The meter circuit uses a full-wave rectifier in order to double the ripple frequency that passes through the meter and thus to prevent the needle from vibrating visibly at 20 Hz. Resistors are used in place of two of the rectifiers in the conventional full-wave bridge in order to linearize the relation between meter indication and signal level, and to minimize distortion. No dc amplification was incorporated into the meter circuit, so that there is no need for a dc zero adjustment on the front panel and no possibility of dc zero instability. High-impedance, crystal-type earphones can be connected to the output terminals.

Operation–Section 3

3.1 USE AS AN AMPLIFIER OR PREAMPLIFIER.

To use the Type 1232-A or -AP Tuned Amplifier and Null Detector as an amplifier:

a. Connect the input signal to the INPUT connector of the Type 1232 or, if used, the Type 1232-P2. Adaptors for connectors other than Type 874 are available from General Radio. If the output impedance of the source of this signal is greater than 100 kΩ, set the switch on the Type 1232-P2, if used, to HIGH Z; otherwise set the switch to LOW Z.

NOTE

For connection to binding posts, use a Type 874-R34 Patch Cord. (Hum pickup is too great with a Type 874-Q2 Adaptor.)

b. Set the METER switch to LINEAR –20 dB (unless maximum sensitivity is required.)

c. Set the FILTER FREQUENCY switch for the desired characteristic: FLAT, 20-200 Hz, 200 Hz – 2 kHz, 2-20 kHz, 50 kHz, or 100 kHz.

d. With the GAIN control, turn the instrument on and adjust the gain to the desired level. The total range of the GAIN control is 120 dB, and attenuation in dB is roughly proportional to the rotation angle of the control knob.

e. The OUTPUT terminals may be connected to an oscilloscope or headphones. The red binding post is high, the black binding post is ground.

The high sensitivity of this instrument permits its use as a preamplifier for transducer outputs or oscilloscope input.

3.2 USE AS A NULL DETECTOR FOR BRIDGE BALANCING.

To use this instrument as a detector for bridge measurements;

a. Connect the INPUT terminals of the Type 1232-A or -AP to the DETECTOR terminals of the bridge as in paragraph 3.1, step a.

b. Set the METER switch to LOG.

c. Set the FILTER FREQUENCY and FILTER TUNING controls to the desired frequency.

d. With generator and unknown connected to the bridge, set the GAIN control of the Type 1232-A for approximately half-scale deflection of the output meter, and tune the FILTER TUNING control for maximum output.

The bridge balance can now be made in the conventional manner, by readjustment of the GAIN control as balance is approached.

3.3 USE IN AUDIO SPECTRUM ANALYSIS.

The tuned amplifier can be used as an audio-frequency wave analyzer with a sensitivity of 1 μV and a bandwidth of about 5 percent. For approximate measurements, the gain can be assumed to be constant with frequency. More accurate measurements can be obtained if the amplifier is first calibrated with a constant-amplitude, variable-frequency signal. The typical variation of peak response vs frequency is shown in Figure 5.

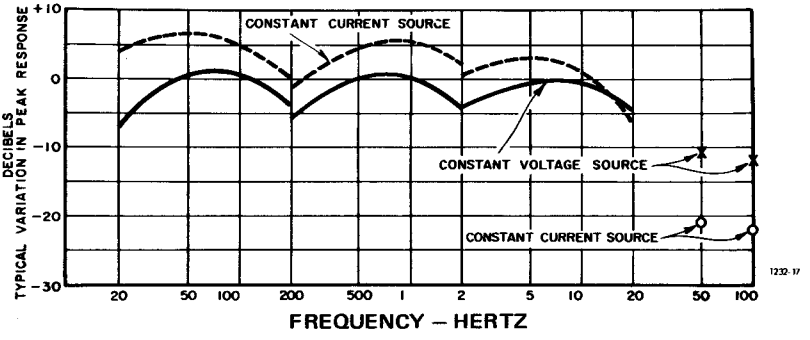


Figure 5. Typical variation in peak response with frequency for constant gain-control setting.

Service and Maintenance–Section 4

4.1 GR FIELD SERVICE.

Our warranty attests the quality of materials and workmanship in our products. When difficulties do occur, our service engineers will assist in any way possible. If the difficulty cannot be eliminated by use of the following service instructions, please write or phone the nearest GR service facility (see back page), giving full information of the trouble and of steps taken to remedy it. Describe the instrument by type, serial, and ID numbers. (Refer to front and rear panels.)

Before returning an instrument to General Radio for service, please ask our nearest office for a "Returned Material" number. Use of this number in correspondence and on a tag tied to the instrument will ensure proper handling and identification. After the initial warranty period, please avoid unnecessary delay by indicating how payment will be made, i.e., send a purchase-order number or (for transportation charges) request "C.O.D."

For return shipment, please use packaging that is adequate to protect the instrument from damage, i.e., equivalent to the original packaging. Advice may be obtained from any GR office.

4.2 REMOVAL OF COVER.

To open the instrument for access to transistors and components, loosen the two fluted captive screws at the rear of the instrument and slide the U-shaped dust cover away from the panel. All transistors and components are now accessible.

4.3 BATTERY INSTALLATION.

The Type 1232-A Tuned Amplifier and Null Detector is powered by nine M72 mercury batteries (Mallory RM-4R or equivalent), which will last for over 1500 hours with normal use. For a simple check of the batteries, measure the dc voltage between anchor terminal 6 and ground. This should be 12 V.

To replace the batteries, remove the cap (twist counterclockwise and pull out) on the right-hand side of the instrument under the M72 CELLS engraving. Insert the 1¼ in. spacer (P/N 1232-6010) in the opening on the right-hand side of the instrument, under the M72 CELLS engraving. Push it in to the end of the compartment. Then, insert the nine batteries with the positive (+) terminal as marked on the battery facing into the instrument. Finally place the cap (battery-keeper assembly, P/N 1650-2120) in position, twisiting it approximately ¼ turn in either direction to lock it in position.

4.4 INTERNAL NOISE.

4.4.1 Noise Indicated by Meter.

At certain frequencies the sensitivity of the Type 1232-A Tuned Amplifier and Null Detector greatly exceeds the catalog specifications. With maximum gain at these frequencies, the noise generated by transistor Q100 normally causes large deflection of the output meter. For maximum useful gain, the GAIN control should be set low enough so that the noise level at the output is not greater than 10 percent of full scale.

For minimum sensitivity to hum pickup and stray fields, input connections must be shielded. Do not use an adaptor from the Type 874 INPUT connector to binding posts; use a shielded Type 874 cable.

If, with completely shielded input connections, the noise level of the Type 1232-A greatly exceeds the values given in Figure 6, the noise is probably caused by Q100. If it is necessary to replace this transistor, a replacement with a high β (beta) will usually give the lowest noise levels.

It is possible, but not likely, that Q101 will contribute significantly to the internal noise.

4.4.2 Noise From the Type 1232-P2.

The equivalent noise sources of the Type 1232-AP with the FILTER FREQUENCY set to 100 Hz are a current source of less than 0.1 $\mu\mu$A and a voltage source of less than 0.3 μV. If the noise levels of the Type 1232 alone do not exceed the values of Figure 6, yet the Type 1232-AP will not meet the above specifications, replace the transistor in the Type 1232-P2.

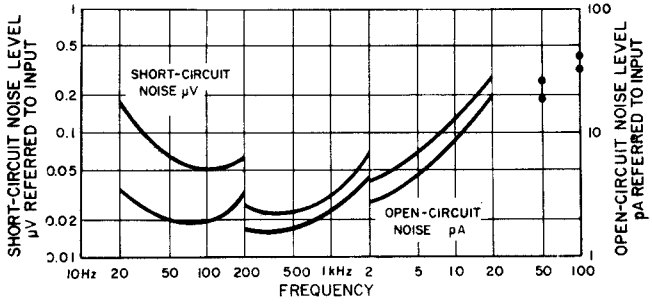


Figure 6. Typical noise levels as a function of frequency.

4.4.3 Output Noise.

Due to the large amount of amplification that follows the GAIN control there is always a small amount of noise present at the OUTPUT terminals. At minimum gain, and with the FILTER FREQUENCY control set to FLAT or with a FILTER FREQUENCY of 5 kHz or lower, this noise should be less than 50 mV with the METER switch set to MAX SENS and should cause no more than 1 per-

cent deflection of the output meter. With the METER switch set to LINEAR –20 dB, this noise should be less than 5 mV.

If the noise is greater than 50 mV with minimum gain and MAX SENS switch setting, the trouble is probably caused by Q200, Q201, or Q202. If this noise level is less than 50 mV and the noise with LINEAR –20 dB switch setting is greater than 5 mV, the faulty component is probably Q203, Q204, or Q205.

4.5 TRANSISTOR VOLTAGE AND RESISTANCE MEASUREMENTS.

Table 2 gives the normal voltage and resistance measurements from transistor terminals to ground. A deviation of 10 percent from any of these values is not necessarily abnormal.

1. Before making transistor voltage measurements, make sure that the battery voltage is approximately 12 V (refer to paragraph 4.3). Turn the instrument on but leave the GAIN control counterclockwise, set the FILTER FREQUENCY, switch to FLAT and the METER switch to LINEAR –20 dB. Measure voltage with a high impedance voltmeter.

2. Before making resistance measurements, remove all the batteries and short-circuit anchor terminal 6 to ground. Remove all transistors. Set the GAIN control to OFF, the FILTER FREQUENCY switch to FLAT, and the METER switch to LINEAR –20 dB.

TABLE 2
VOLTAGES AND RESISTANCES

Transistor (Type)	Term.	Dc Volts To Ground	Ohms To Ground	Transistor (Type)	Term.	Dc Volts To Ground	Ohms To Ground
Q100	C	7.8	222 k	Q202	C	0	0
	E	3.6	220 k		E	3.5	11 k
	B	3.7	3.3 M		B	3.3	22 k
Q101	C	11.6	2.2 k	Q203	C	1.7	100 k
	E	7.7	40 k		E	0.4	4.7 k
	B	7.8	222 k		B	0.5	42 k
Q200	C	7.4	34 k	Q204	C	3.6	47 k
	E	3.6	33 k		E	1.6	10 k
	B	3.7	120 k		B	1.7	100 k
Q201	C	3.3	22 k	Q205	C	7.2	4.4 k
	E	7.8	23 k		E	3.5	3.3 k
	B	7.4	34 k		B	3.6	47 k
Q101 of Type 1232-P2	D	12.0	3.2 k				
	S	0.7 to 2.5	10k				
	G	*	1 G				

* Impedance too high to permit measurement.

4.6 TRIMMER-CAPACITOR ADJUSTMENT.

Normally, the factory-set trimmer capacitor adjustment (C202) will not require attention. However, adjustment may be necessary if transistor Q201, Q203, or Q204 is replaced. If the frequency response for the FLAT characteristic is outside the specified limits, adjust the trimmer capacitor as follows:

a. With the FILTER FREQUENCY switch set at FLAT and a 1-kHz signal at the INPUT connector, adjust the GAIN control for a 5-dB meter indication.

b. With the GAIN and FILTER FREQUENCY controls unchanged, apply a 100-kHz signal (of the same amplitude as the 1-kHz signal) to the INPUT connector and adjust the trimmer capacitor, C202, for a meter indication of 5 dB. Check the frequency response below 100 kHz to make sure it is within the specified limits.

c. With same settings, use continuously variable source to check that response is flat within ±3 dB from 20 Hz to 100 kHz. Adjust with C202, if necessary.

4.7 MINIMUM PERFORMANCE STANDARDS.

4.7.1 General

The following tests are provided to demonstrate compliance of the 1232-A with published specifications at incoming inspection or following repair or calibration.

4.7.2 Test Equipment

The items listed in Table 3 are recommended for performance of the ensuing tests.

Table 3

Instrument	Recommended Type*
Decade Voltage Divider	GR 1455-B
Counter	GR 1192-B
Coaxial Adaptor	GR 874-Q10
Patch Cord	GR 776-A
Patch Cord	GR 776-B
Patch Cord	GR 274-NP
Shielded Patch Cord	GR 874-R34
Oscillator	GR 1310-B
Voltmeter	hp 400E
Short-Circuit Termination	GR 874-WNL
Open-Circuit Termination	GR 874-WO
Insertion Unit	GR 874-X
5.1 MΩ resistors, 5% (2 required)	———

*Or equivalent.

4.7.3 Noise Check

Connect the Voltmeter to the 1232-A OUTPUT terminals (via the 776-A Patch Cord and set controls as follows:

a. Voltmeter RANGE switch to 0.1 volts.

b. 1232-A METER switch to MAX SENS.

c. 1232-A FILTER FREQUENCY switch to FLAT.

d. 1232-A GAIN control on, but fully ccw.

The voltmeter indication (noise) should be .03-V maximum.

4.7.4 Filter Tuning Dial.

Connect equipment as shown in Figure 7.

Set controls as follows:

a. Set oscillator to 1 kHz at 1 V output.
b. Set 1455-B to .00100 (1 mV output.)
c. Set 1192 in FREQUENCY mode.
d. Set 1192 range switch to 1 s GATE TIME.
e. Set 1192 DISPLAY control at 1 s.
f. Set 1192 INPUT ATTEN at 1:1.
g. Set 1232-A FILTER FREQUENCY switch to 200 Hz – 2 kHz.
h. Set 1232-A METER switch to MAX SENS.

Set the FILTER TUNING dial on the 1232-A to each of the numbered points (2, 3, 4, 5, 7, 10, 15, 20) and adjust the 1232-A GAIN and the 1310 frequency for a peak reading on the 1232-A meter. In each case, the frequency read on the 1192 should be within ±3% of the nominal value on the 1232-A FILTER TUNING dial. (See Table 4).

Table 4
OSCILLATOR FREQUENCY SETTINGS

Hz	Hz
194-206	679-721
291-309	970-1030
388-412	1455-1545
485-515	1940-2060

Repeat the test at 100 Hz, 20 Hz, and 200 Hz on the 20-200 Hz range, and at 2, 10, and 20 kHz on the 2-20 kHz range. Also check 50- and 100-kHz (via the 1232-A FILTER FREQUENCY switch). In each case set the switch to its proper position before setting the frequency. The FILTER TUNING dial is not in the circuit at 50- and 100 kHz. At each step the FILTER TUNING dial should be accurate to within ±3% of the frequency read on the 1192.

4.7.5 Frequency Response

Set the following controls (same set-up as above):

a. Set oscillator to 1 kHz at 1 V output.
b. Set 1455-B to .01000 (10 mV.)
c. Set 1232-A FILTER FREQUENCY switch to FLAT.

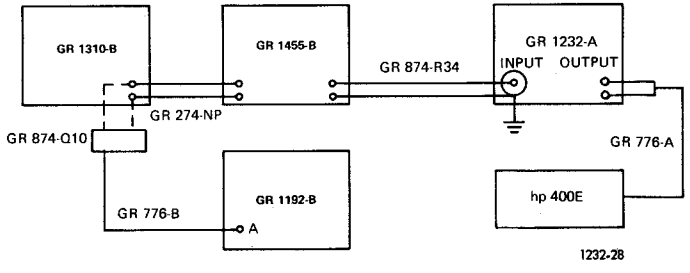


Figure 7. Filter Tuning Dial Test Set-up.

d. Set 1232-A METER switch to MAX SENS.

e. Adjust 1232-A GAIN for a 5 dB reading on the 1232-A meter. Change the frequency to 100 kHz and note a 1232-A meter reading of 2 - 8dB.

With a constant input voltage, the frequency response from 100 kHz to 20 Hz should be between 2 and 8 dB.

Repeat the test at 100 Hz, 10 kHz, 50 kHz, and 100 kHz, adjusting the GAIN control for a 5 dB deflection in each case. Adjust the output of the 1310-B to 1 V at the start of each frequency test.

4.7.6 Gain

Set the following:

a. Set oscillator to 1 kHz at 1 V output.
b. Set 1455-B to .9999X (1 V.)
c. Set 1232-A FILTER TUNING dial to 10.
d. Set 1232-A FILTER FREQUENCY switch to 200 Hz-2 kHz.
e. Set 1232-A METER switch to MAX SENS.

Under these conditions it must be possible to adjust the 1232-A GAIN control for a full-scale reading on the 1232-A meter.

Repeat the test for full-scale deflection with the 1455-B set to .00001 and the 1310-B adjusted to 100 mV.

Set the GAIN control 135° clockwise from the off position and adjust the 1455-B for a full scale reading of the 1232-A meter. The 1455-B should indicate between .00320 and .03200 (320 μV—3.2 mV.)

4.7.7 Meter Linearity

Set the following controls:

a. Set the oscillator to 1 kHz at 1 V output.
b. Set the 1455-B to .00320 (3.2 mV.)
c. Set the 1232-A FILTER FREQUENCY switch to FLAT.
d. Set the 1232-A METER switch to MAX SENS.

Adjust the GAIN control for full-scale (0 dB) on the 1232-A meter. Decrease the 1455-B output to 1.8 mV (65 dB); the 1232-A meter should indicate 4.7 to 5.3 dB.

Decrease the 1455-B output to 1 mV (.00100). The 1232-A meter should now read 9.5 to 10.5 dB.

Change the 1455-B output to 100 μV (.00010) and adjust the 1232-A GAIN for a full-scale reading on the 1232-A meter. Make the following checks:

1232-A METER switch	1455-B Output	1232-A meter must read:
–20 dB	.00010	5 to 7
LOG	.00010	40 to 60
LOG	.00010	Adjust GAIN to 20
LOG	.00100	60 to 90
LOG	.01000	80 to 100
LOG	.10000	greater than previous reading*

*If reading goes down, the batteries may need replacement.

4.7.8 Signal to Noise Ratio

Disconnect the 1192 from the set-up of Figure 7 and connect the voltmeter to the 1232-A OUTPUT. Set controls as follows:

a. Set oscillator to 20 Hz at 100 mV output.
b. Set 1232-A FILTER TUNING dial to 2.
c. Set 1232-A FILTER FREQUENCY switch to 20-200 Hz.
d. Set 1232-A METER switch to MAX SENS.

Disconnect the 1455-B from the 1232-A and short the 1232-A input with the 874-WNL. Adjust the GAIN control for an indication of 0.1 V on the voltmeter. Remove the input short and reconnect the 1455-B to the 1232-A INPUT. Adjust the 1455-B for an indication of 1.0 V on the voltmeter; this should require an output of 10 μV maximum on the 1455-B.

Repeat the above procedure, for the following conditions:

Frequency*	Setting†
1 kHz	3.5 μV
10 kHz	8 μV
100 kHz	30 μV

Set 1232 to 20 Hz. Disconnect the 1455-B and install the 874-WO at the 1232-A INPUT. Adjust GAIN for 0.1 V on the voltmeter. Remove the 874-WO. Connect, to the 1232-A input, a fixture consisting of two 5.1-MΩ resistors in series within the 874-X Insertion Unit. Connect the 1455-B to the other end of the fixture. With the oscillator at 20 Hz, adjust the 1455-B to produce a 1.0-V reading on the voltmeter. The 1455-B output should be 1 mV maximum.

Repeat the above procedure for the following conditions:

Frequency*	Setting†
1 kHz	700 μV
10 kHz	2 mV
100 kHz	15 mV

4.7.9 Harmonic Rejection

Use the set-up of Figure 7 and set controls as follows:

a. Set oscillator to 1 kHz at 100 mV.
b. Set 1455-B to .00001 (1 μV).
c. Set 1232-A FILTER TUNING dial at 10.
d. Set 1232-A FILTER FREQUENCY switch at 200 Hz-2 kHz.
e. Set 1232-A METER switch at MAX SENS.

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*Set filter tuning dials and filter frequency switch for appropriate frequencies.
†Max. 1455-B setting to give 1.0-V reading on hp400E.

Adjust the GAIN control for a full-scale reading on the 1232-A meter. Set the oscillator at the following frequencies, and in each case readjust the output of the 1455-B to give a full-scale reading of the 1232-A meter. The 1455-B should indicate as follows:

Frequency	Minimum 1455-B output voltage
2 kHz	63 μV (36 dB)
10 kHz	3.2 mV (70 dB)*
500 Hz	16 μV (24 dB)
60 Hz	1 mV (60 dB)

Reset the oscillator to 100 Hz and the 1455-B to 1 μV. With the 1232-A RANGE at 20-200 Hz, adjust the FILTER TUNING dial for a peak and adjust the GAIN control for a full-scale reading of the 1232-A meter. Change the oscillator to 200 Hz and readjust the 1455-B for a full-scale 1232-A meter reading. The 1455-B output must be 57 μV (35 dB) minimum.

Set the oscillator to 10 kHz (as indicated on the 1192-B) at a 100 mV output. Set the 1455-B to .01000 (1 mV). With the 1232-A range at 2-20 kHz, adjust the FILTER TUNING dial for peak response on the 1232-A meter. Adjust GAIN for full-scale deflection. Turn the FILTER TUNING dial ccw to obtain a meter reading 3 dB below full scale. Turn the oscillator frequency dial ccw through a peak meter indication and beyond, until the 1232-A meter again reads 3 dB below full scale. The frequency, indicated on 1192 should be between 10.30 and 10.50 kHz.

Reset the oscillator to 10 kHz, the 1455-B to 1 μV and the FILTER TUNING dial to 10. Tune the FILTER TUNING dial for a peak and adjust the GAIN for a full-scale deflection on the 1232-A meter. Change the oscillator to 20 kHz and readjust the 1455-B output for a full-scale reading on the 1232-A meter. The 1455-B must indicate 57 μV (35 dB) minimum.

Set the oscillator to 50 kHz, the 1455-B to .00005 (5 μV), and the FILTER FREQUENCY switch to 50 kHz. Adjust GAIN for full-scale on the 1232-A meter. Set the oscillator at the following frequencies, and in each case readjust the 1455-B output to give a full-scale reading on the 1232-A:

Frequency	Minimum 1455-B output voltage
100 kHz	1 mV (60 dB)
10 kHz	1.4 mV (63 dB)

Set the oscillator to 100 kHz at 100 mV output, the 1455-B to .00010 (10 μV), and the FILTER FREQUENCY switch to 100 kHz. Adjust GAIN for full-scale on the 1232-A. Set the oscillator at the following frequencies, and in each case readjust the 1455-B output to give a full-scale reading on the 1232-A:

*May not be able to get full-scale reading on 1232 with large input signal from 1455-B. Transistors in 1232 have reached max gain.

Frequency	Minimum 1455-B output voltage
20 kHz	1 mV (60 dB)
200 kHz	3.2 mV (70 dB)

4.7.10 External Filter

Set the oscillator to 10 kHz at 1 V output, the 1455-B to .00010 (100 μV), the FILTER FREQUENCY switch to FLAT, and the METER switch to MAX SENS. Connect the external filter, (set for 10-kHz band pass), to the EXTERNAL FILTER jack on the side of the 1232-A. Adjust the oscillator for peak reading on 1232-A, then adjust GAIN for full-scale. Change 1310 frequency to 100 kHz. Adjust the 1455-B for full-scale reading on the 1232-A meter. The 1455-B must indicate 1 mV (60 dB) minimum.

4.8 KNOBS

If it should be necessary to remove a 1232 knob, to replace a damaged switch or knob, proceed as follows:

a. Grasp the knob firmly with the fingers, close to the panel, and pull the knob straight away from the panel.

b. Observe the position of the set screw in the bushing with respect to any panel markings.

c. Release the set screw and pull the housing off the shaft, using an Allen wrench.

NOTE

To separate the bushing from the knob, if for any reason they should be combined off the instrument;drive a machine tap a turn or two into the bushing for sufficient grip for easy separation.

To install the snap-on knob assembly on the control shaft:

a. Mount the bushing on the shaft, using a small slotted piece of wrapping paper as a shim for adequate panel clearance.

b. Orient the set screw on the bushing with respect to the panel marking index and lock the set screw with an Allen wrench.

NOTE

Make sure the end of the shaft does not protrude through the bushing or the knob will not set properly.

c. Place the knob on the bushing with the retention spring opposite the set screw.

d. Push the knob in until it bottoms in the groove in the bushing.

NOTE

If the retention spring in the knob becomes loose, reinstall it in the interior notch with the small slit in the wall.

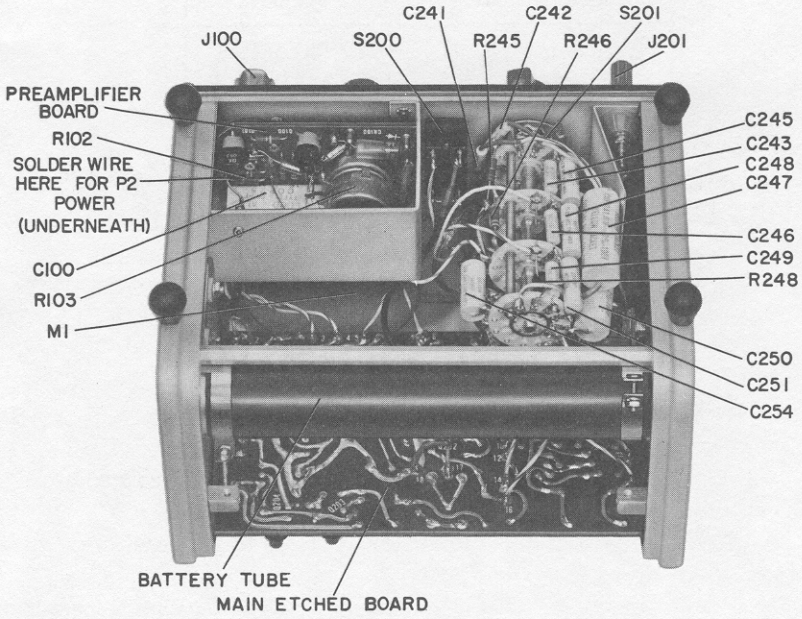


Figure 8. Bottom interior view of the Type 1232-A.

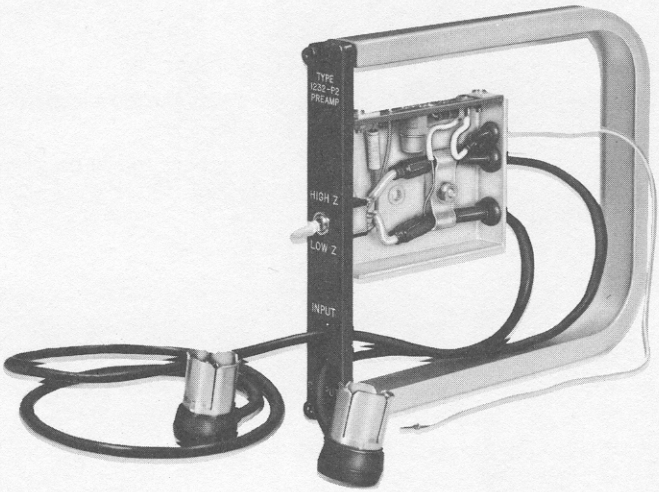


Figure 9. Interior of the Type 1232-P2.

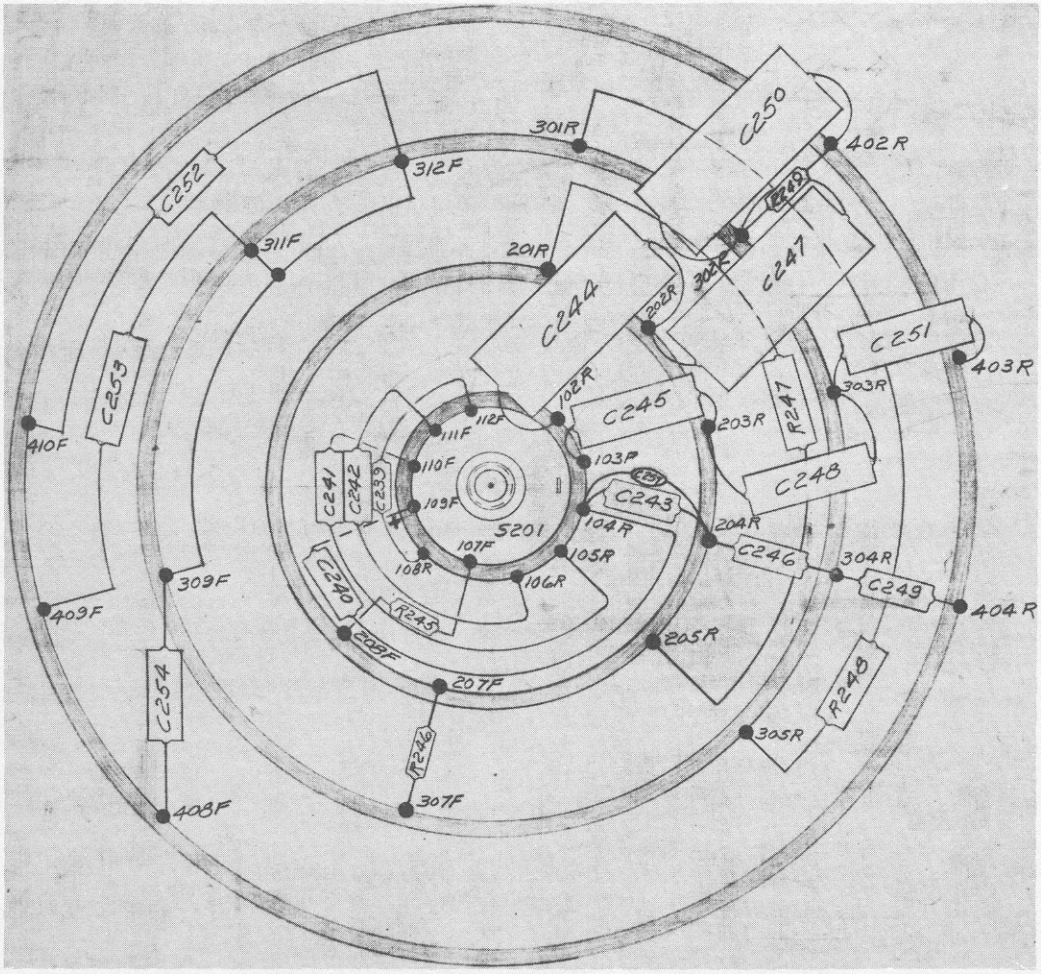


Figure 10. S201 wiring details. The 100-series lugs are at the panel end.

4.9 INSTRUMENT METER WINDOW CARE

The clear acrylic meter window can become susceptible to electrostatic-charge buildup and can be scratched, if improperly cleaned. It is treated inside and out in manufacturing with a special non-abrasive anti-static solution, Statnul*, which normally should preclude any interference in meter operation caused by electrostatic effects. The problem is evidenced by the inability of the meter movement to return promptly to a zero reading, once it is deenergized. As supplied, the meter should return to zero reading within 30 seconds, immediately following the placement of a static charge, as by rubbing the outside surface. This meets the requirements of ANSI standard C39.1-1972.

If static-charge problems occur, possibly as the result of frequent cleaning, the window should be carefully polished with a soft dry cloth, such as cheesecloth or nylon chiffon. Then, a coating of Statnul should be applied with the polishing cloth.

CAUTION

Do not use any kind of solvent. Kleenex or paper towels can scratch the window surface.

If it should be necessary to place limit marks on the meter window, paper-based masking tape is recommended, rather than any kind of marking pen, which could be abrasive or react chemically with the acrylic.

*Available from Mancib Co., Burlington, MA 01803

ELECTRICAL PARTS LIST

CHASSIS MOUNTED PARTS P/N 1232-3010

	REFDES		DESCRIPTION	PART NO.	FMC	MFGR PART NUMBER
*	BT	1	BATTERY 1.35V MERCURIC OXIDE M72	8410-1372	09823	HG-4R
	C	239	CAP TANT 6.8 UF 20PCT 6V	4450-4800	56289	150D685X0006A2
	C	240	CAP MYLAR .015UF 10 PCT 100V	4860-7655	56289	410P .015 UF 10PCT
	C	241	CAP MYLAR .0022UF 10 PCT 200V	4860-7329	56289	410P .0022 UF 10PCT
	C	242	CAP MYLAR .001UF 10 PCT 200V	4860-7309	56289	410P .001 UF 10PCT
	C	243	CAP MYLAR .00947UF 1 PCT 100V	4860-7553	56289	410P .00947 UF 1PCT
	C	244	CAP MYLAR 1UF 1 PCT 100V	4860-8003	56289	410P 1 UF 1PCT 100V
	C	245	CAP MYLAR .1UF 1 PCT 100V	4860-8249	56289	410P 0.1 UF 1PCT
	C	246	CAP MYLAR .01UF 1 PCT 100V	4860-7752	56289	410P .01 UF 1PCT
	C	247	CAP MYLAR 1UF 1 PCT 100V	4860-8003	56289	410P 1 UF 1PCT 100V
	C	248	CAP MYLAR .1UF 1 PCT 100V	4860-8249	56289	410P 0.1 UF 1PCT
	C	249	CAP MYLAR .01UF 1 PCT 100V	4860-7752	56289	410P .01 UF 1PCT
	C	250	CAP MYLAR 1UF 1 PCT 100V	4860-8003	56289	410P 1 UF 1PCT 100V
	C	251	CAP MYLAR .1UF 1 PCT 100V	4860-8249	56289	410P 0.1 UF 1PCT
	C	252	CAP MYLAR .0033UF 10 PCT 200V	4860-7359	56289	410P .0033 UF 10PCT
	C	253	CAP MYLAR .047UF 10 PCT 100V	4860-8200	56289	410P .047 UF 10PCT
	C	254	CAP MYLAR .22UF 10 PCT 100V	4860-7981	56289	410P 0.22 UF 10PCT
	C	257	CAP CER DISC 100PF 5PCT 500V	4404-1105	72982	0831082Z5D00101J
	J	100	PANEL CONNECTOR	0874-4181	24655	0874-4181
	J	102	CONNECTOR JACK	4260-0400	82389	2J-1439
	J	103	JACK SINGLE .080 PIN	4260-1010	98291	SKT-0804
	J	200	BINDING POST ASM	0938-3000	24655	0938-3000
	J	201	BINDING POST ASM	0938-3000	24655	0938-3000
	M	1	METER	5730-1220	24655	5730-1220
	Q	100	TRANSISTOR 2N4384	8210-1131	56289	2N4384
	Q	101	TRANSISTOR 2N4384	8210-1131	56289	2N4384
	Q	200	TRANSISTOR 2N4384	8210-1131	56289	2N4384
	Q	201	TRANSISTOR 2N4250	8210-1294	07263	2N4250
	Q	202	TRANSISTOR 2N4250	8210-1294	07263	2N4250
	Q	203	TRANSISTOR 2N3903	8210-1132	04713	2N3903
	Q	204	TRANSISTOR 2N3903	8210-1132	04713	2N3903
	Q	205	TRANSISTOR 2N3903	8210-1132	04713	2N3903
	R	245	RES COMP 1.8 K 5PCT 1/2W	6100-2185	81349	RCR20G182J
	R	246	RES COMP 3.3 K 5PCT 1/2W	6100-2335	81349	RCR20G332J
	R	247	RES FLM 19.6 OHM 1 PCT 1/2W	6450-9196	81349	RN65D19R6F
	R	248	RES FLM 6.65K 1 PCT 1/2W	6450-1665	81349	RN65D6651F
	R	249	RES COMP 200 K OHM 5PCT 1/2W	6100-4205	81349	RCR20G204J
	R	250	POTENTIOMETER	0975-4040	24655	0975-4040
	S	200	SWITCH TOGGLE 3POS DP STEADY	7910-0820	04009	82609
	S	201	SWITCH ROTARY ASM	7890-2410	24655	7890-2410

TUNED AMPLIFIER PC BOARD P/N 1232-2701

REFDES		DESCRIPTION	PART NO.	FMC	MFGR PART NUMBER
C	100	CAP MYLAR 0.15UF 10 PCT 600V	4860-9400	56289	411P 0.15 UF 10PCT
C	101	CAP TANT 1.0 UF 20PCT 35V	4450-4300	56289	150D105X0035A2
C	102	CAP ALUM 100 UF 15V	4450-2800	56289	30D107G015
C	103	CAP TANT 6.8 UF 20PCT 6V	4450-4800	56289	150D685X0006A2
C	104	CAP TANT 4.7 UF 20PCT 10V	4450-4700	56289	150D475X0010A2
CR	100	DIODE RECTIFIER 1N4003	6081-1001	14433	1N4003
CR	101	DIODE RECTIFIER 1N4003	6081-1001	14433	1N4003
CR	102	DIODE RECTIFIER 1N4003	6081-1001	14433	1N4003
CR	103	DIODE RECTIFIER 1N4003	6081-1001	14433	1N4003
R	100	RES COMP 3.3 M 5PCT 1/2W	6100-5335	81349	RCR20G335J
R	101	RES COMP 220 K 5PCT 1/2W	6100-4225	81349	RCR20G224J
R	102	RES COMP 2.2 K 5PCT 1/2W	6100-2225	81349	RCR20G222J
R	103	POTENTIOMETER	1232-0400	24655	1232-0400
R	104	RES COMP 220 K 5PCT 1/2W	6100-4225	81349	RCR20G224J
R	105	RES COMP 22 K 5PCT 1/2W	6100-3225	81349	RCR20G223J
R	106	RES COMP 18 K 5PCT 1/2W	6100-3185	81349	RCR20G183J
S	100	POTENTIOMETER	1232-0400	24655	1232-0400

* 9 BATTERIES REQUIRED

ELECTRICAL PARTS LIST

PC BOARD P/N 1232-2711

REFDES	DESCRIPTION	PART NO.	FMC	MFGR PART NUMBER
C 200	CAP ALUM 5 UF 50V	4450-3900	56289	30D505G050
C 201	CAP MICA 220 PF 5PCT 500V	4700-0519	81349	CM05FD221JN
C 202	CAP CER TRIM 8-50 PF	4910-1170	72982	557-051 E 8-50PF
C 204	CAP MICA 30 PF 5PCT 500V	4700-0237	81349	CM05ED300JN
C 205	CAP ALUM 200 UF 6V	4450-2610	56289	30D207G006
C 206	CAP MICA 100 PF 5PCT 500V	4700-0660	81349	CM05FD101JN
C 207	CAP ALUM 100 UF 15V	4450-2800	56289	30D107G015
C 208	CAP ALUM 100 UF 15V	4450-2800	56289	30D107G015
C 209	CAP MYLAR .22UF 10 PCT 100V	4860-7981	56289	410P 0.22 UF 10PCT
C 210	CAP TANT 10 UF 20PCT 20V	4450-5100	56289	150D106X0020B2
C 211	CAP CER TUB 680PF 5PCT 500V NM 0V NM	4404-1685	72982	315Z5R680PF10PCT500
C 212	CAP ALUM 5 UF 50 V	4450-3900	56289	30D505G050
C 213	CAP CER TUB 680PF 5PCT 500 V NM 0V NM	4404-1685	72982	315Z5R680PF10PCT500
C 214	CAP ALUM 5 UF 50V	4450-3900	56289	30D505G050
C 215	CAP ALUM 5 UF 50V	4450-3900	56289	30D505G050
C 216	CAP ALUM 5 UF 50V	4450-3900	56289	30D505G050
C 217	CAP ALUM 15 UF 15V	4450-3700	56289	30D156G015
C 218	CAP ALUM 5 UF 50V	4450-3900	56289	30D505G050
C 219	CAP MYLAR .464UF 2 PCT 100V	4860-7990	56289	410P 0.464 UF 2PCT
C 220	CAP MYLAR .464UF 2 PCT 100V	4860-7990	56289	410P 0.464 UF 2PCT
C 221	CAP MYLAR .464UF 2 PCT 100V	4860-7990	56289	410P 0.464 UF 2PCT
C 222	CAP MICA 464PF 1PCT 500V	4710-0535	81349	CM05FD464FN
C 223	CAP MICA 464PF 1PCT 500V	4710-0535	81349	CM05FD464FN
C 224	CAP MICA 464PF 1PCT 500V	4710-0535	81349	CM05FD464FN
C 225	CAP MICA 1000PF 1PCT 500V	4710-0100	81349	CM06FD102FN
C 226	CAP MICA 1000PF 1PCT 500V	4710-0100	81349	CM06FD102FN
C 227	CAP MICA 1000PF 1PCT 500V	4710-0100	81349	CM06FD102FN
C 230	CAP MYLAR .01UF 2 PCT 100V	4860-7650	56289	410P .01 UF 2PCT
C 231	CAP MYLAR .00681UF 2 PCT 200V	4860-7505	56289	410P .00681 UF 2PCT
C 255	CAP TANT 4.7 UF 20PCT 10V	4450-4700	56289	150D475X0010A2
C 256	CAP MICA 1000 PF 5PCT 500V	4700-1190	81349	CM06FD102JN
CR 200	DIODE RECTIFIER 1N4003	6081-1001	14433	1N4003
CR 201	DIODE RECTIFIER 1N4003	6081-1001	14433	1N4003
CR 202	DIODE RECTIFIER 1N4003	6081-1001	14433	1N4003
CR 203	DIODE RECTIFIER 1N4003	6081-1001	14433	1N4003
CR 204	DIODE 1N191 90PIV IR 125UA GE	6082-1008	14433	1N191
CR 205	DIODE 1N191 90PIV IR 125UA GE	6082-1008	14433	1N191
L 201	CHOKE MOLDED 1000 UH 10PCT	4300-5000	99800	3500-32
L 202	CHOKE MOLDED 390 UH 10PCT	4300-4390	99800	3500-22
R 200	RES COMP 33 K 5PCT 1/2W	6100-3335	81349	RCR20G333J
R 201	RES COMP 33 K 5PCT 1/2W	6100-3335	81349	RCR20G333J
R 203	RES COMP 1.0 K 5PCT 1/2W	6100-2105	81349	RCR20G102J
R 204	RES COMP 220 K 5PCT 1/2W	6100-4225	81349	RCR20G224J
R 205	RES COMP 220 K 5PCT 1/2W	6100-4225	81349	RCR20G224J
R 206	RES COMP 1.0 K 5PCT 1/2W	6100-2105	81349	RCR20G102J
R 207	RES COMP 22 K 5PCT 1/2W	6100-3225	81349	RCR20G223J
R 208	RES COMP 470 OHM 5PCT 1/2W	6100-1475	81349	RCR20G471J
R 210	RES COMP 22 K 5PCT 1/2W	6100-3225	81349	RCR20G223J
R 211	RES COMP 10 OHM 5PCT 1/2W	6100-0105	81349	RCR20G100J
R 212	RES COMP 10 K 5PCT 1/2W	6100-3105	81349	RCR20G103J
R 213	RES COMP 470 OHM 5PCT 1/2W	6100-1475	81349	RCR20G471J
R 214	RES COMP 110 K OHM 5PCT 1/2W	6100-4115	81349	RCR20G114J
R 215	RES COMP 150 K 5PCT 1/2W	6100-4155	81349	RCR20G154J
R 216	RES COMP 27 K 5PCT 1/2W	6100-3275	81349	RCR20G273J
R 217	RES COMP 47 K 5PCT 1/2W	6100-3475	81349	RCR20G473J
R 218	RES COMP 100 K 5PCT 1/2W	6100-4105	81349	RCR20G104J
R 220	RES COMP 4.7 K 5PCT 1/2W	6100-2475	81349	RCR20G472J
R 221	RES COMP 2.7 K 5PCT 1/2W	6100-2275	81349	RCR20G272J
R 222	RES COMP 47 K 5PCT 1/2W	6100-3475	81349	RCR20G473J
R 223	RES COMP 10 K 5PCT 1/2W	6100-3105	81349	RCR20G103J
R 224	RES COMP 12 K 5PCT 1/2W	6100-3125	81349	RCR20G123J
R 225	RES COMP 3.9 K 5PCT 1/2W	6100-2395	81349	RCR20G392J
R 226	RES COMP 3.3 K 5PCT 1/2W	6100-2335	81349	RCR20G332J
R 227	RES COMP 1.8 K 5PCT 1/2W	6100-2185	81349	RCR20G182J
R 228	RES COMP 3.0 K OHM 5PCT 1/2W	6100-2305	81349	RCR20G302J
R 230	RES COMP 9.1 K OHM 5PCT 1/2W	6100-2915	81349	RCR20G912J
R 231	RES COMP 22 K 5PCT 1/2W	6100-3225	81349	RCR20G223J
R 232	RES COMP 9.1 K OHM 5PCT 1/2W	6100-2915	81349	RCR20G912J
R 233	RES FLM 31.6K 1 PCT 1/8W	6250-2316	81349	RN55D3162F
R 234	RES FLM 31.6K 1 PCT 1/8W	6250-2316	81349	RN55D3162F

ELECTRICAL PARTS LIST (cont)

NULL DETECTOR PC BOARD P/N 1232-2711

REFDES	DESCRIPTION	PART NO.	FMC	MFGR PART NUMBER
R 235	RES FLM 3.32K 1 PCT 1/8W	6250-1332	81349	RN55D3321F
R 236	RES FLM 3.32K 1 PCT 1/8W	6250-1332	81349	RN55D3321F
R 237	RES FLM 40.2K 1 PCT 1/8W	6250-2402	81349	RN55D4022F
R 238	RES COMP 1.0 K 5PCT 1/2W	6100-2105	81349	RCR20G102J
R 239	RES FLM 5.11K 1 PCT 1/8W	6250-1511	81349	RN55D5111F
R 240	RES FLM 5.11K 1 PCT 1/8W	6250-1511	81349	RN55D5111F
R 241	RES FLM 1.1K 1 PCT 1/8W	6250-1110	81349	RN55D1101F
R 242	RES FLM 4.99K 1 PCT 1/8W	6250-1499	81349	RN55D4991F
R 243	RES FLM 4.99K 1 PCT 1/8W	6250-1499	81349	RN55D4991F
R 244	RES FLM 1.05K 1 PCT 1/8W	6250-1105	81349	RN55D1051F
R 251	RES COMP 2.7 K 5PCT 1/2W	6100-2275	81349	RCR20G272J

MECHANICAL PARTS LIST

DESCRIPTION	PART NO.	FMC	MFGR PART NUMBER
FILTER TUNING KNOB ASM	5520-5520	24655	5520-5520
GAIN & FILTER FREQ KNOB ASM	5500-5221	24655	5500-5221
BATTERY HOLDER TUBE	1232-6000	24655	1232-6000
FILTER TUNING DIAL INDICATOR	5470-0650	24655	5470-0650
RIGHT END FRAME ASM	5310-3066	24655	5310-3066
LEFT END FRAME ASM	5310-3067	24655	5310-3067
FEET (4 REQUIRED)	5260-0700	24655	5260-0700

ELECTRICAL PARTS LIST

1232-P2 PREAMPLIFIER CHASSIS MOUNTED PARTS

REFDES	DESCRIPTION	PART NO.	FMC	MFGR PART NUMBER
S 101	SWITCH TOG MIN 2POS DPDT STEADY	7910-0791	95146	MTA-206N

1232-P2 PREAMPLIFIER PC BOARD P/N 1232-2730

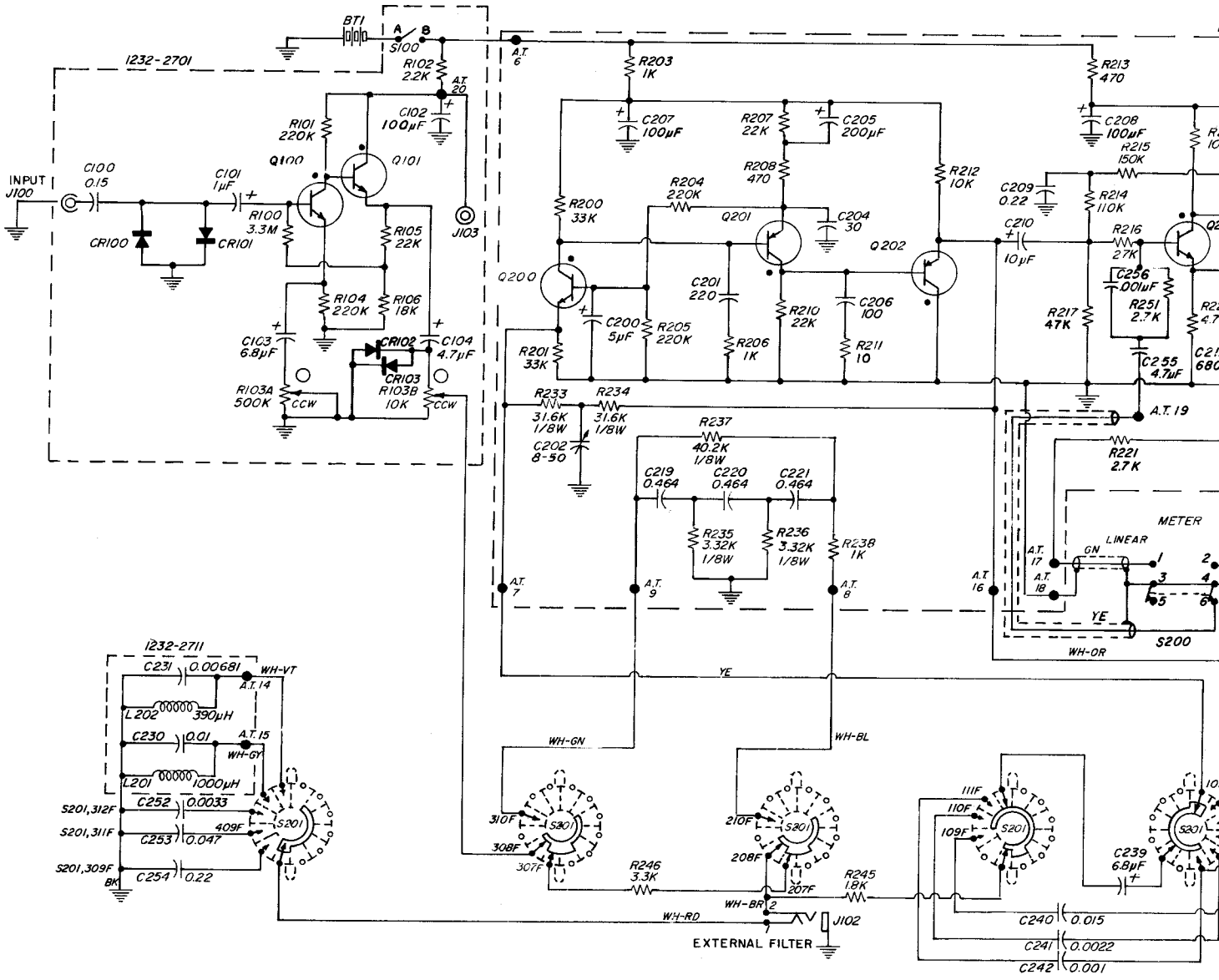
REFDES	DESCRIPTION	PART NO.	FMC	MFGR PART NUMBER
C 101	CAP MYLAR .001UF 10 PCT 200V	4860-7309	56289	410P .001 UF 10PCT
Q 101	TRANSISTOR 2N3457	8210-1082	17856	2N3457
R 101	RES COMP 1.0 G 20PCT 1/2W	6100-3108	81349	RCR20G108
R 102	RES COMP 10 K 5PCT 1/2W	6100-3105	81349	RCR20G103J
R 103	RES COMP 1.0 K 5PCT 1/2W	6100-2105	81349	RCR20G102J

FEDERAL SUPPLY CODE
FOR MANUFACTURERS

From Defense Logistics Agency Microfiche
H4-2 SB 708-42 GSA-FSS H4-2

Ref FMC Column
in Parts Lists

Code	Manufacturer
00136	McCoy Elctrns.,Mt.Holly Springs,PA 17065
00192	Jones Mfg.,Chicago,IL 60181
00194	Waleo Elctrns.,Los Angeles,CA 90018
00227	Welwyn Instrt.,Westlake,OH 44145
00434	Schweber Elctrns.,Westburg,NY 11590
00656	Aerovox.,New Bedford,MA 02745
00779	AMP Inc.,Harrisburg,PA 17105
01009	Alden Products.,Brockton,MA 02413
01121	Allen Bradley.,Milwaukee,WI 53204
01255	Litton Indx.,Beverly Hills,CA 90213
01281	TRW.,Lawndale,CA 90260
01295	TI.,Dallas,TX 75222
01526	GE.,Waynesboro,VA 22980
01930	Amerock.,Rockford,IL 61101
01963	Cherry Elctrc.,Waukegan,IL 60085
02111	Spectrol Elctrns.,City of Industry,CA 91745
02114	Ferroxcube.,Saugerties,NY 12477
02606	Fenwell Lab.,Morton Grove,IL 60053
02639	GE.,Schenectady,NY 12307
02660	Amphenol.,Broadview,IL 60153
02735	RCA.,Somerville,NJ 08876
02768	Fastex.,Desplains,IL 60016
03042	Cartar Ink.,Compton,CA 90220
03508	GE.,Syracuse,NY 13201
03550	Vanguard Elctrns.,Inglewood,CA 90302
03636	Greyburne.,Yonkers,NY 10701
03677	Transitron Elctrnc.,Wakefield,MA 01880
03888	KDI Pyrofilm.,Whippeny,NJ 07981
03911	Clairex.,New York,NY 10001
04009	Arrow Hart.,Hartford,CT 06106
04043	Digitronics.,Albanton,NY 12057
04713	Motorola.,Phoenix,AZ 85008
04819	Component Mfg.,W.Bridgewater,MA 02379
05079	Tansistor Elctrns.,Bennington,VT 05201
05245	Corcom.,Chicago,IL 60639
05276	ITT Elctrns.,Pomona,CA 91766
05402	Controls Co.of Amer.,Melrose Pk,IL 60160
05574	Viking Indx.,Chatsworth,CA 91311
05624	Barber Colmen.,Rockford,IL 61101
05748	Barnes Mfg.,Mansfield,OH 44901
05820	Wakefield Eng.,Wakefield,MA 01880
05383	Panduit.,Tinley Pk,IL 60477
06406	Truelove & Maclean.,Waterbury,CT 06708
06665	Precision Monolith.,Santa Clara,CA 95050
06743	Clevite.;Cleveland,OH 44110
06795	WLS Stamp.,Cleveland,OH 44104
06915	Richco Plstc.,Chicago,IL 60646
06928	Teledyne Kntss.,Soland Bch,CA 92075
06978	Aladdin Elctrns.,Nashville,TN 37210
07047	Ross Milton.,Southampton,PA 18966
07126	Digitran.,Pasadena,CA 91105
07127	Eagle Signal.,Baraboo,WI 53913
07233	Cinch Graphic.,City of Industry,CA 91744
07281	Avnet.,Culver City,CA 90230
07283	Fairchild.,Mountain View,CA 94040
07387	Birtcher.,N.Los Angeles,CA 90032
07595	Amer.Semicond.,Arlington Hts,IL 60004
07699	Magnetic Core.,Newburgh,NY 12550
07707	USM Fastener.,Shelton,CT 06484
07828	Bodine.,Bridgeport,CT 06605
07829	Bodine Elctrc.,Chicago,IL 60618
07910	Cont Device.,Hawthorne,CA 90250
07983	State Labs.,New York,NY 10003
07999	Borg Inst.,Delavan,WI 53115
08524	Deutsch Fastener.,Los Angeles,CA 90045
08566	Bell Elctrc.,Chicago,IL 60632
08730	Vernaline Prod.,Franklin Lakes,NJ 07417
09213	GE.,Buffalo,NY 14220
09353	C&K Components.,Watertown,MA 02172
09408	Ser-Tronics.,Georgetown,MA 01830
09823	Burgess Battery.,Freeport,IL 61032
09856	Fenwel Elctrns.,Framingham,MA 01701
09922	Burndy.,Norwalk,CT 06852
10025	Glassel Prod.,Linden,NJ 07036
10389	Chicago Switch.,City,IL 60647
11236	CTS of Berne.,Berne,IN 46711
11599	Chandler Evans.,W.Hartford,CT 06101
11983	Nortronics.,Minneapolis,MN 55427
12040	National.,Santa Clara,CA 95051
12045	Elctrc Transistors.,Flushing,NY 11354
12498	Teledyne.,Mountain View,CA 94043
12617	Hamlin.,Lake Mills,WI 53551
12672	RCA.,Woodbridge,NJ 07095
12697	Clarostat.,Dover,NH 03820
12856	Micrometals.,City of Industry,CA 91744
12954	Dickson Elctrns.,Scottsdale,AZ 85252
12969	Unitrode.,Watertown,MA 02172
13084	Electrocraft.,Hopkins,MN 55343
13103	Thermalloy.,Dallas,TX 75234
13148	Vogue Inst.,Richmond Hill,NY 11418
13150	Vemitron.,Lsconia,NH 03246
13327	Solitron Devices.,Tappan,NY 10983
13715	Fairchild.,San Rafael,CA 94903
13919	Burr Brown.,Tucson,AZ 85706
14010	Anadex Inst.,Van Nuys,CA 91406
14195	Elctrc Controls.,Wilton,CT 06897
14196	American Labs.,Fullerton,CA 92634
14332	Relton.,Arcadia,CA 91006
14433	ITT.,W.Palm Beach,FL 33402
14482	Watkins & Johnson.,Palo Alto,CA 94304
14606	Corbin.,Berlin,CT 06037
14655	Cornell Dubilier.,Newak,NJ 07101
14674	Corning Glass.,Corning,NY 14830
14749	Acopian.,Easton,PA 18042
14752	Electrocube.,San Gabriel,CA 91776
14888	R&G Sloan.,Sun Valley,CA 91352
14908	Elctrc Inst & Spclty.,Stoneham,MA 02180
14936	General Inst.,Hicksville,NY 11802
15238	ITT.,Lawrence,MA 08142
15478	Digital Equip.,Maynard,MA 01754
15605	Cutler Hammer.,Milwaukee,WI 53202
15782	Houston Inst.,Bellaire,TX 77401
15801	Fenwal Elctrns.,Framingham,MA 01701
15819	Sinclair & Rush.,St.Louis,MO 63111
16037	Spruce Pine Mica.,Spruce Pine,NC 28777
16088	Intrnl Diode.,Jersey City,NJ 07304
16179	Ommi Spectra.,Farmington,MI 48024
16301	Astrolab.,Linden,NJ 07036
16352	Codi.,Fairlawn,NJ 07410
16485	Sterling Inst.,New Hyde Park,NY 11040
16636	Indiana General.,Oglesby,IL 61348
16758	Delco.,Kokomo,IN 46901
16950	Precision Dynamics.,Burbank,CA 91504
16952	Amer Micro Devices.,Summerville,SC 29483
17117	Elctrc Molding.,Woonsocket,RI 02895
17540	Mohawk Spring.,Schiller Park,IL 60176
17745	Angstrohm Precn.,Hagerstown,MD 21740
17771	Singer.,Somerville,NJ 08876
17850	Zeltex.,Concord,CA 94520
17856	Silicon!x.,Santa Clara,CA 95054
18324	Signetics.,Sunnyvale,CA 94086
18542	New Prod Eng.,Wabash,IN 46992
18677	Cooke.,Del Monte,CA 91731
18736	Computer Diode.,S.Fairlawn,NJ 07936
18795	Cycon.,Sunnyvale,CA 94086
18911	Durant.,Watertown,WI 53094
19178	Zero.,Monson,MA 01057
19209	GE.,Gainesville,FL 32601
19373	Eastron.,Haverhill,MA 01830
19396	Paktron.,Vienna,VA 22180
19617	Cabtron.,Chicago,IL 60622
19644	LRC Elctrn.,Honeoads,NY 14845
19701	Electra.,Independence,KS 67301
20093	Elect Inds.,Murray Hill,NJ 07974
20754	KMC.,Long Valley,NJ 07853
21335	Fairchild Semicon.,San Jose,CA 95150
21688	Raytheon.,Norwood,MA 02062
21759	Lanox Fugle.,Watchung,NJ 07060
22526	Berg Elctrns.,New Cumberland,PA 17070
22680	Electro Spec Fabrctrs.,Topton,PA 19562
22753	UID Elctrns.,Hollywood,FL 33022
23338	Wavetek.,San Diego,CA 92112
23342	Avnet Elctrcs.,Franklin Park,IL 60131
23936	Pamotor.,Bulingham,CA 94010
24351	Indiana Genl Elctrc.,Lewisburg,IN 08832
24355	Analog Devices.,Cambridge,MA 02142
24444	General Semicond.,Tempe,AZ 85281
24446	GE.,Schenectady,NY 12305
24454	GE.,Syracuse,NY 13201
24455	GE.,Cleveland,OH 44112
24602	EMC Technlgy.,Cherry Hill,NJ 08034
24655	Gen Rad.,Concord,MA 01742
24759	Lanox Fugle.,S.Plainfield,NJ 07080
25008	Vactite.,Berkeley,CA 94710
25269	EG&G.,Bedford,MA 01730
26601	Tri-County Tube.,Nunda,NY 14517
26805	Omni Spectra.,Waltham,MA 02154
26806	American Kettle.,Gardena,CA 92626
27014	National.,Santa Clara,CA 95051
27545	Hartford Universal Ball.,Rocky Hill,CT 06067
28480	HP.,Palo Alto,CA 94304
28520	Heyman Mfg.,Kenilworth,NJ 07033
28875	IMC Magnetics.,Rochester,NH 03867
28960	Hoffman Elctrcs.,El Monte,CA 91734
30043	Solid State Devices.,LaMirada,CA 90638
30648	Beckman Inst.,Cedar Grove,NJ 07009
30874	IBM.,Armonk,NY 10504
30985	Permag Magnetics.,Toledo,OH 43609
31019	Solid State Scntfc.,Montgomeryville,PA 18936
31514	Standford Applid Engs.,Costa Mesa,CA 92626
31814	Analogic.,Peabody,MA 01960
31961	Triridge.,Pittsburgh,PA 15231
32001	Jensen.,Chicago,IL 60638
33095	Spectrum Control.,Fairview,PA 16415
33173	GE.,Owensboro,KY 42301
34141	Koehler.,Marlboro,MA 01752
34156	Semicos.,Costa Mesa,CA 92626
34333	Silicon Genrl.,Westminster,CA 92683
34335	Advanced Micro Devices.,Sunnyvale,CA 94086
34649	Intel.,Santa Clara,CA 95051
34677	Solitron Devices.,Jupiter,FL 33458
35929	Constants.,Montreal,QUE,CAN
36422	National Ltd.,Montreal,QUE,CAN
37942	Mallory.,Indianapolis,IN 46206
38443	Marlin Rockwell.,Jamestown,NY 14701
39317	McGill Mfg.,Valparaiso,IN 46383
40031	Honeywell.,Minneapolis,MN 55408
42190	Muter.,Chicago,IL 60638
42498	National.,Melrose,MA 02176
43334	New Departure-Hyatt.,Sandusky,OH 44870
43991	Norma Hoffman.,Stanford,CT 06904
49671	RCA.,New York,NY 10020
49956	Raytheon.,Waltham,MA 02154
50088	Mostek.,Carrollton,TX 75006
50101	GHZ Devices.,S.Chelmsford,MA 01824
50507	Micro Networks.,Worcester,MA 01606
50522	Monsanto.,Palo Alto,CA 94304
50721	Datel Systems.,Canton,MA 02021
51167	Aries Elctrcs.,Frenchtown,NJ 08825
51563	Diablo Systems.,Hayward,CA 94545
51642	Centre Eng.,State College,PA 16801
52648	Plessey.,Santa Ana,CA 92705
52676	SKF Inds.,Philadelphia,PA 19132
52763	Stettner Trush.,Cazenovia,NY 13035
53021	Sangamo Elctrc.,Springfield,IL 62705
53184	Xciton.,Lasham,NY 12110
53421	Tyton.,Milwaukee,WI 53209
54294	Shallcross.,Selma,NC 27576
54297	Assoc Prec Prod.,Huntsville,AL 35805
54715	Shure Bros.,Evanston,IL 60202
56289	Sprague.,North Adams,MA 01247
57771	Stimpson.,Bayport,NY 11705
58553	Superior Valve.,Washington,PA 15301
59730	Thomas & Betts.,Elizabeth,NJ 07207
59675	TRW.,Cleveland,OH 44117
60395	Torrington.,Torrington,CT 06790
61007	Townsend.,Braintree,MA 02184
61637	Union Carbide.,New York,NY 10017
61864	United Carr Fast.,Boston,MA
63060	Victoreen.,Cleveland,OH 44104
63743	Ward Leonard.,Mt.Vernon,NY 10550
65083	Westinghouse.,Bloomfield,NJ 07003
65092	Weston.,Newark,NJ 07114
70106	Amphenol Cap.,New Bedford,MA 02742
70109	Adams & Westlake.,Elkhart,IN 46514
70417	Chrysler.,Detroit,MI 48231
70485	Atlantic Indis Rubber.,Chicago,IL 60607
70563	Amperite.,Union City,NJ 07087
70611	Ark-Les Switch.,Watertown,MA 02172
70892	Bead Chain.,Bridgeport,CT 06605
70903	Belden.,Chicago,IL 60644
71126	Bronson.,Beacon Falls,CT 06403
71279	Cambridge Thermionic.,Cambridge,MA 02138
71294	Canfield.,Clifton Forge,VA 24422
71400	Bussmann.,St.Louis,MO 63107
71450	CTS.,Elkhart,IN 46514
71468	Cannon.,Los Angeles,CA 90031
71482	Ckre.,Chicago,IL 60645
71590	Centralab.,Milwaukee,WI 53212
71666	Continental Carbon.,New York,NY
71707	Coto Coil.,Providence,RI 02905
71729	Crescent Bio.,Philadelphia,PA 19134
71744	Chicago Min Lamp.,Chicago,IL 60640
71785	Cinch.,Chicago,IL 60624
71823	Darnell.,Downey,CA 90241
71828	Electromotive.,Willimantic,CT 06226
72228	Continental Screw.,New Bedford,MA 02742
72259	Nytronics.,Berkeley Hts,NJ 07922
72619	Dialight.,Brooklyn,NY 11237
72699	General Inst.,Newark,NJ 07104
72785	Drake.,Chicago,IL 60631
72794	Dzus Fastener.,W.Islip,NY 11795
72825	Eby.,Philadelphia,PA 19144
72962	Elastic Stop Nut.,Union,NJ 07083
72982	Erie.,Erie,PA 16512
73445	Amperex Elctrcs.,Hicksville,NY 11801
73559	Carling Elctrc.,Hartford,CT 06110
73660	Elco Resistor.,New York,NY
73803	TI.,Attleboro,MA 02703
73899	JFD Elctrcs.,Brooklyn,NY 11219
73967	Groov-Pin.,Ridgefield,NJ 07657
74193	Heinemann.,Trenton,NJ 08602
74199	Quam Nichols.,Chicago,IL 60637
74446	Holo-Krome.,Hartford,CT 06110
74545	Hubbell.,Stratford,CT 06497
74861	Industrial Cndnsr.,Chicago,IL 60618
74868	Amphenol.,Danbury,CT 06810
74970	Johnson.,Wasaca,MN 56093
75042	IRC(TRW).,Burlington,IA 52601
75376	Kurz-Kasch.,Dayton,OH 45401
75382	Kuka.,Mt Vernon,NY 10651
75491	Lafayette.,Syosset,NY 11791
75606	Linden.,Providence,RI 02905
75915	Littelfuse.,Des Plains,IL 60016
76005	Lord Mfg.,Erie,PA 16512
76149	Mallory Elctrc.,Indianapolis,IN 46204
76241	Maurey.,Chicago,IL 60618
76381	3 M Co.,St.Paul,MN 55101
76385	Minor Rubber.,Bloomfield,NJ 07003
76497	Millen.,Malden,MA 02148
76546	Mueller Elctr.,Cleveland,OH 44114
76684	National Tube.,Pittsburg,PA
76854	Oak Inds.,Crystal Lake,IL 60014
77132	Dot Fastener.,Waterbury,CT 06720
77147	Hyton Nasc(Guyer.,Providence,RI 02905
77166	Pas Seymour.,Syracuse,NY 13209
77263	Pierce Roberts Rubber.,Trenton,NJ 08638
77316	Platt Bros.,Waterbury,CT 06720
77339	Positive Lockwasher.,Newark,NJ
77342	AMF.,Princeton,IN 47570
77542	Ray-o-Vac.,Madison,WI 53703
77630	TRW.,Camden,NJ 08103
77638	General Inst.,Brooklyn,NY 11211
78189	Shakeproof.,Elgin,IL 60120
78277	Sigma Inst.,Braintree,MA 02184
78429	Airco Speer.,St Marys,PA 15867
78488	Stackpole,St Marys,PA 15867
78553	Tinnerman.,Cleveland,OH
78711	Telephonics.,Huntington,NY 11743
79098	RCA.,Harrison,NJ 07029
79136	Weldes Kohinoor.,New York,NY 11101
79487	Weckesser.,Chicago,IL 60626
79725	Wiremold.,Hartford,CT 06110
79727	Continental Wirt.,Philadelphia,PA 19101
79840	Mallory Controls.,Frankfort,IN 46041
79963	Zierick.,Mt Kisco,NY 10549
80009	Tektronix.,Beaverton,OR 97005
80030	Prestole Fastener.,Toledo,OH 43605
80048	Vickers,St Louis,MO 63166
80103	Lambda.,Melville,NY 11746
80133	Sprague.,N.Adams,MA 01247
80211	Motorola.,Franklin Pk,IL 60131
80251	Formica.,Cincinnati,OH 45232
80258	Standard Oil.,Lafeyette,IN 47902
80294	Bourns Labs.,Riverside,CA 92506
80368	Sylvania.,New York,NY 10017
80431	Air Filter.,Milwaukee,WI 53218
80683	Hammarlund.,New York,NY 10010
80740	Beckman Inst.,Fullerton,CA 92634
80756	TRW Ramsey.,St Louis,MO 63166
80894	Pure Carbon.,St Marys,PA 15857
81030	Int'l Inst.,Orange,CT 06477
81073	Grayhill.,LaGrange,IL 60525
81143	Isolantite.,Stirling,NJ 07980
81312	Winchester.,Oakville,CT 06779
81349	Military Specifications
81350	Joint Army-Navy Specifications
81483	Int'l Rectifier.,El Segundo,CA 90245
81741	Chicago Lock.,Chicago,IL 60641
81831	Filtron.,Flushing,NY 11354
81840	Ladex.,Dayton,OH 45402
81860	Berry Wright.,Watertown,MA 02172
82219	Sylvania.,Emporium,PA 15834
82227	Ne.Amer.Philips.,Cheshire,CT 06410
82273	IN Pattern & Model.,LaPort,IN 46350
82389	Switchcraft.,Chicago,IL 60630
82567	Reeves Hoffman.,Carlisle,PA 17013
82647	Metals & Controls.,Attleboro,MA 02703
82807	Milwaukee Resistor.,Milwaukee,WI 53204
82877	Rotron.,Woodstock,NY 12498
82901	IN General Magnet.,Valparaiso,IN 46383
83003	Varo.,Garland,TX 75040
83014	Marshall.,Placentia,CA 92670
83033	Meisner.,Mt Carmel,IL 62863
83058	Carr Fastener.,Cambridge,MA 02142
83186	Victory Eng.,Springfield,NJ 07081
83298	Parker Seal.,Culver City,CA 90231
83330	H.H.Smith.,Brooklyn,NY 11207
83361	Bearing Spclty.,San Francisco,CA
83587	Solar Elctrc.,Warren,PA 16365
83594	Burroughs.,Plainfield,NJ 07061
83740	Union Carbide.,New York,NY 10017
83786	Mas Engrg.,Quincy,MA 02171
83781	National Elctrcs.,Geneva,IL 60134
84411	TRW.,Ogallala,NB 69153
84535	Lehigh Metals.,Cambridge,MA 02140
84970	Sarkas Terzian.,Bloomington,IN 47401
84971	TA Mfg.,Los Angeles,CA 90039
85604	Kepco.,Flushing,NY 11352
85420	Pyrocon Custom.,Gurnee,IL 60031
86577	Prec Metal Prod.,Stoneham,MA 02180
86684	RCA.,Harrison,NJ 07029
86687	REC.,New Rochelle,NY 10801
86900	Cont Elctrcs.,Brooklyn,NY 11222
88140	Cutler Hammer.,Lincoln,IL 62656
88204	GTE Sylvania.,Ipswitch,MA 01938
88219	Gould Nat Battery.,Trenton,NJ 08607
88419	Cornell Dubilier.,Fuquay Varina,NC 27526
88627	K&G Mfr.,New York,NY
89265	Potter & Brumfield.,Princeton,IN 47671
89482	Holtzer Cabot.,Boston,MA 02119
89665	United Transformer.,Chicago,IL
89870	Heinrichs Transformer.,Kent,CT 06757
90201	Mallory Cap.,Indianapolis,IN 46206
90303	Mallory Bat.,Tarrytown,NY 10591
90634	Gulton Indx.,Metuchen,NJ 08840
90750	Westinghouse.,Boston,MA 02118
90952	Hardware Prod.,Reading,PA 19602
91032	Continental Wire.,York,PA 17405
91146	Cannon.,Salem,MA 01970
91210	Gerber.,Mishawaka,IN 46544
91293	Johanson.,Boonton,NJ 07005
91417	Harris.,Melbourne,FL 32901
91506	Augat Bros.,Attleboro,MA 02703
91586	Chandler.,Wethersfield,CT 06109
91637	Dale Elctrcs.,Columbus,NE 68601
91662	Elco.,Willow Grove,PA 19090
91719	General Inst.,Dallas,TX 75220
91836	Kings Elctrcs.,Tuckahoe,NY 11223
91918	Methode.,Rolling Meadow,IL 60008
91929	Honeywell.,Freeport,IL 61032
92519	Electra Insul.,Woodside,NY 11377
92678	Edgerton Germeshausen.,Boston,MA 02115
92702	IMC Magnetics.,Westbury,NY 11591
92739	Aerpax.,Redwood City,CA 94063
92968	Hudson Lamp.,Kearny,NJ 07032
93332	Sylvania.,Woburn,MA 01801
93346	Amer Elctrcs Labs.,Lansdale,PA 19446
93618	R&C Mfg.,Ramsey,PA 18671
93916	Cramer.,New York,NY 10013
94144	Raytheon.,Quincy,MA 02169
94154	Wagner Elctrc.,Livingston,NJ 07039
94211	Weston.,Archbald,PA 18403
94322	Tel Labs.,Manchester,NH 03102
94588	Dickson.,Chicago,IL 60619
94696	Magnecraft.,Chicago,IL 60630
94800	Atlas Ind.,Brooklne,NH 03033
95076	Arcole.,Cleveland,OH 02864
95121	Quality Comp.,St Marys,PA 15857
96146	Alco Elctrcs.,Lawrence,MA 01843
96238	Continental Conn.,Woodside,NY 11377
96275	Vitramon.,E Bridgeport,CT 06601
96348	Gordos.,Bloomfield,NJ 07003
96354	Methode.,Rolling Meadow,IL 60008
96794	Amer Brass.,Torrington,CT 06790
96987	Weckesser.,Chicago,IL 60646
96095	Aerovox Hi Q.,Olean,NY 14760
96341	Microwave Assoc.,Burlington,MA 01801
96906	Military Standards
97918	Linemaster Switch.,Woodstock,CT 06281
98291	Sealectro.,Mamaroneck,NY 10544
98474	Compar.,Burlingame,CA 94010
98821	North Hills.,Glen Cove,NY 11542
99017	Protective Closures.,Buffalo,NY 14207
99117	Metavac.,Flushing,NY 11368
99313	Varian.,Palo Alto,CA 94303
99378	Atlee.,Winchester,MA 01890
99800	Delevan;E.Aurora,NY 14052
99934	Renbrandt.,Boston,MA 02118
99942	Centralab.,Milwaukee,WI 53201



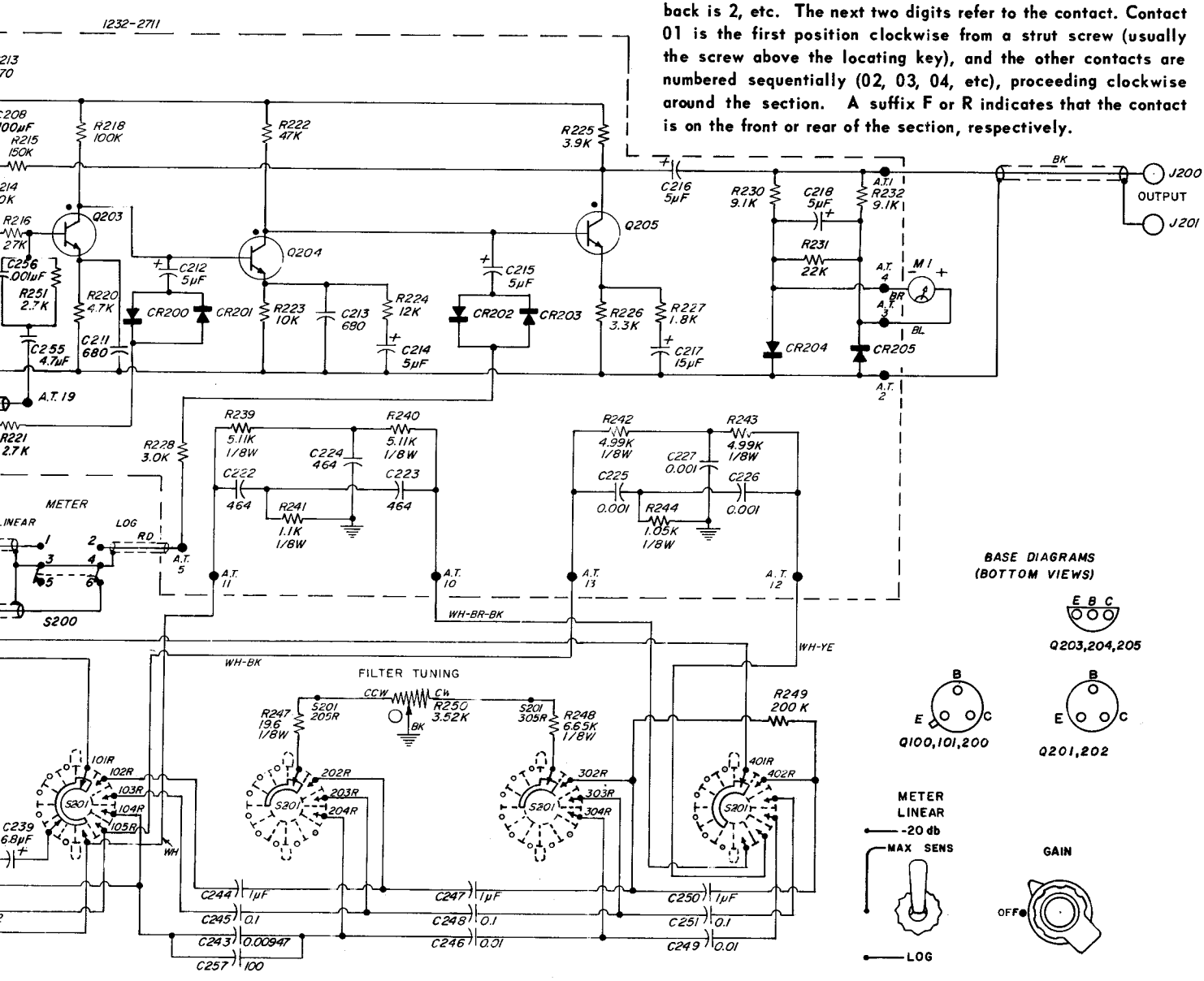
NOTES:

RESISTORS 1/2 WATT UNLESS OTHERWISE SPECIFIED
RESISTANCE IN OHMS UNLESS OTHERWISE SPECIFIED
K = 1000 OHMS M = 1 MEGOHM
CAPACITANCE VALUES ONE AND OVER IN MICRO-MICROFARADS (PICOFARADS), LESS THAN ONE IN MICROFARADS, UNLESS OTHERWISE SPECIFIED

○ KNOB CONTROL

Figure 11. Schematic diagram of the Type 1232-A

Rotary switch sections are shown as viewed from the panel end of the shaft. The first digit of the contact number refers to the section. The section nearest the panel is 1, the next section back is 2, etc. The next two digits refer to the contact. Contact 01 is the first position clockwise from a strut screw (usually the screw above the locating key), and the other contacts are numbered sequentially (02, 03, 04, etc), proceeding clockwise around the section. A suffix F or R indicates that the contact is on the front or rear of the section, respectively.



BASE DIAGRAMS (BOTTOM VIEWS)

Q203,204,205

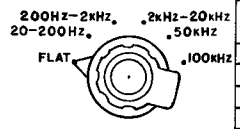
Q100,101,200

Q201,202

S200

S100-R103A-R103B

FILTER FREQUENCY



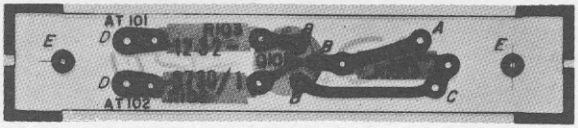
S201 SHOWN IN EXTREME COUNTERCLOCKWISE POSITION

S201 SWITCHING DIAGRAM

SWITCH POSITION	SWITCH SECTIONS							
	1F	1R	2F	2R	3F	3R	4F	4R
FLAT	7-12	1-8	7-8		7-8			
20-200Hz	7-12	1-2-8	7-8	1-2	7-8	1-2	7-8	1-2
200Hz-2kHz	7-12	1-3-8	8-10	1-3	6-10	1-3	7-9	1-3
2kHz-20kHz	7-9	1-4	8-10	1-4	8-10	1-4	7-10	1-4
50kHz	7-10	1-5	8-10		8-10		7-11	1-5
100kHz	7-11	1-6	8-10		8-10		7-12	1-6

pe 1232-A Tuned Amplifier and Null Detector.

Figure 12. Block diagram of the Type 1232-A Tuned Amplifier and Null Detector.



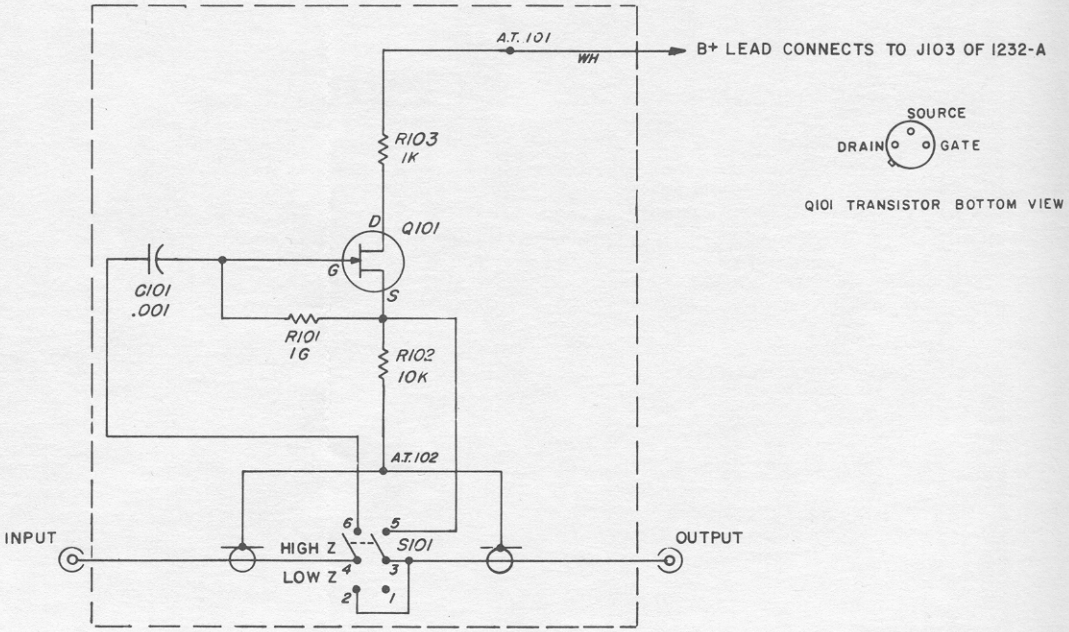


Figure 14. Schematic diagram and etched board layout of the Type 1232-P2 Preamplifier. The etched board part number is 1232-2730.

NOTE: The number appearing on the foil side is not the part number. The dot on the foil at the transistor socket indicates the collector lead.

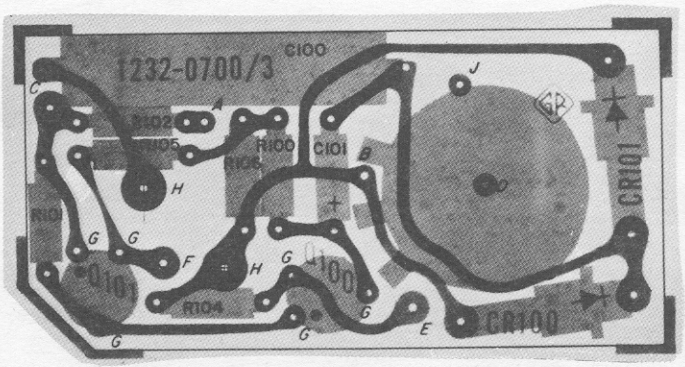


Figure 13. Etched Board Layout of the Type 1232-A Tuned Amplifier and Null Detector, P/N's 1232-2700 and 1232-2710.

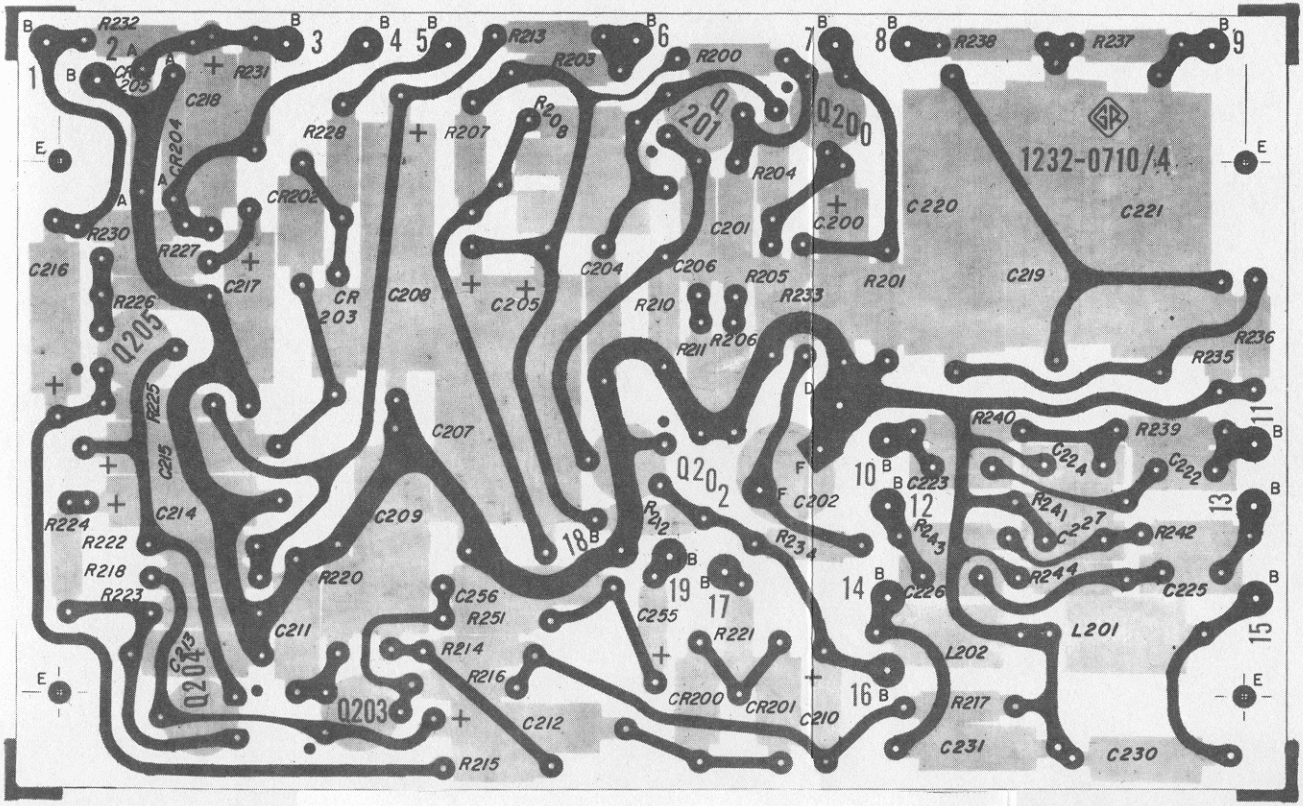
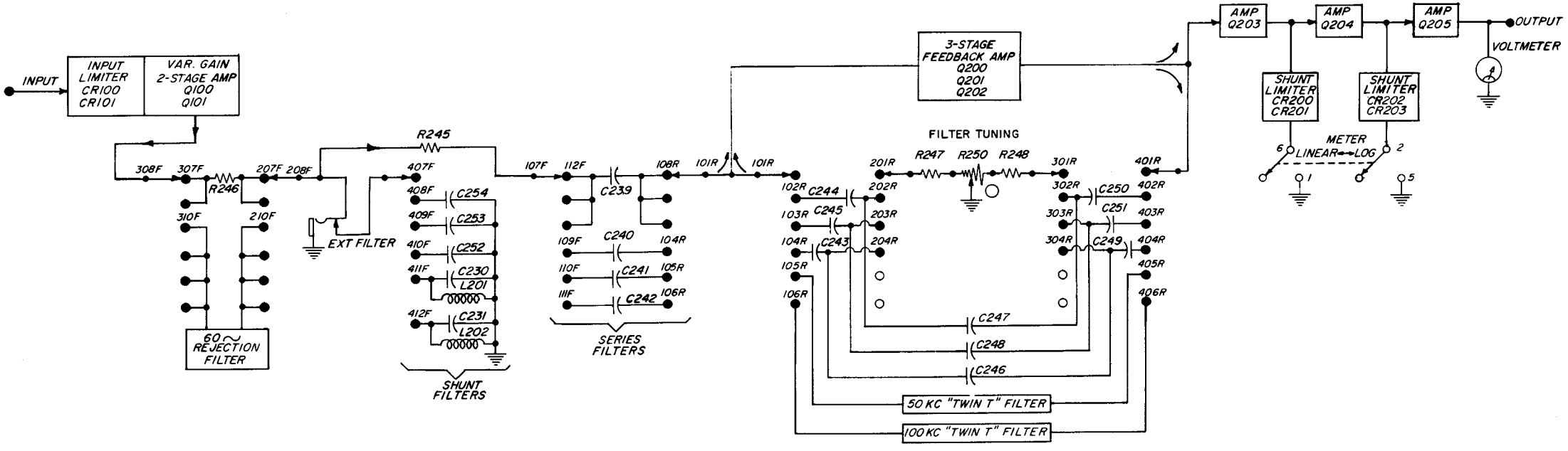


Figure 13. Etched Board Layout of the Type 1232-A Tuned Amplifier and Null Detector, P/N's 1232-2700 and 1232-2710.


INPUT
INPUT LIMITER CR100 CR101
VAR. GAIN 2-STAGE AMP Q100 Q101
308F
307F
R246
207F
208F
310F
210F
60~ REJECTION FILTER
EXT FILTER
R245
407F
408F
C254
409F
C253
410F
C252
411F
C230
L201
412F
C231
L202
SHUNT FILTERS
107F
112F
C239
108R
109F
C240
104R
110F
C241
105R
111F
C242
106R
SERIES FILTERS
101R
101R
3-STAGE FEEDBACK AMP Q200 Q201 Q202
FILTER TUNING
R247
R250
R248
201R
202R
203R
204R
102R
C244
103R
C245
104R
C243
105R
106R
C247
C248
C246
50 KC "TWIN T" FILTER
100 KC "TWIN T" FILTER
301R
302R
303R
304R
C250
C251
C249
401R
402R
403R
404R
405R
406R
AMP Q203
AMP Q204
AMP Q205
OUTPUT
VOLTMETER
SHUNT LIMITER CR200 CR201
SHUNT LIMITER CR202 CR203
METER
LINEAR
LOG
6
2
1
5

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Form 1232-4000
May, 1979
RLW

OPERATING INSTRUCTIONS

TYPE 1232-4000

RECHARGEABLE BATTERY

The Type 1232-4000 Rechargeable Battery (non-mercury) replaces the nine mercury cells (M72) supplied with the standard instrument. The rechargeable battery provides up to 90 hours of operation and can be recharged several hundred times.

The battery assembly includes 9 type CD-4 nickel-cadmium cells sealed in an epoxy cylinder along with a Type 0746-4400 Step-Down Transformer and a 1N3253 charging diode. A power-plug end cap allows connection to a 115-V ac supply for charging.

The nickel-cadmium cells have a rated capacity of 225 mA-hr and a nominal voltage of 1.22 V (11 V total) at normal current. When fully charged, the cells have an open-circuit voltage of about 1.4 V (12.6 V total). When discharged, the cells have an open-circuit voltage of about 1 V (9 V total). With the 2.5-mA drain of the 1232-A Amplifier, the cells will provide 90 hours, or about 2 weeks, of normal operation. When discharged, the cells should be recharged for 14 to 16 hours (e.g., overnight). Avoid overcharging or excessive discharging which will shorten the life of the battery[1].

Disconnect the charging cord when operating the amplifier. In other respects the operation of the instrument is unchanged.

---

[1]Lewis Hofstatter, "Nickel-Cadmium Batteries", Electronics World, October 1965, pg. 37.

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